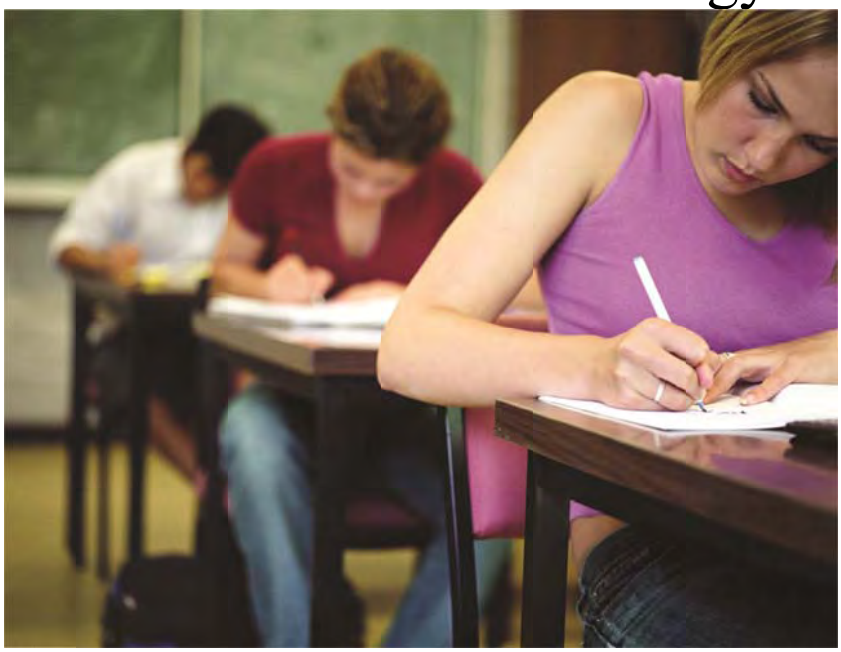
OKLAHOMA SCHOOL TESTING PROGRAM
OKLAHOMA MODIFIED ALTERNATE ASSESSMENT PROGRAM

Test and Item Specifications

Science

End-of-Instruction Biology



OKLAHOMA STATE DEPARTMENT OF EDUCATION
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Oklahoma State Department of Education
Oklahoma City, Oklahoma

Revised October 2012

Purpose

The purpose of this test is to measure Oklahoma students' level of proficiency at the end of instruction in Biology I. On the End-of-Instruction Biology I test, students are required to respond to a variety of items linked to the Biology I process/inquiry standards identified in the *Oklahoma C^3* Standards. All Biology I test forms will assess the identified standards and objectives listed below. The following standards and objectives are intended to summarize the knowledge as identified in *Oklahoma C^3* Standards.

***Oklahoma C^3* Standards** **Biology I** **Process and Inquiry Standards and Objectives**
Observe and Measure (P1.0) • Qualitative/quantitative observations and changes (P1.1) • Use appropriate System International (SI) units and tools (P1.2 & P1.3)
Classify (P2.0) • Use observable properties to classify (P2.1) • Identify properties of a classification system (P2.2)
Experimental Design (P3.0) • Evaluate the design of an investigation (P3.1) • Identify a testable hypothesis, variables, and controls in an experiment (P3.2 & P3.4) • Use mathematics to show relationships (P3.3) • Identify potential hazards and practice safety procedures in all science activities (P3.5)
Interpret and Communicate (P4.0) • Select predictions based on observed patterns of evidence (P4.1) • Interpret line, bar, line, trend, and circle graphs (P4.3) • Accept or reject a hypothesis (P4.4) • Make logical conclusions based on experimental data (P4.5) • Identify an appropriate graph or chart (P4.8)
Model (P5.0) • Interpret a model which explains a given set of observations (P5.1) • Select predictions based on models using mathematics when appropriate (P5.2)

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***Oklahoma C³* Standards** **Biology I** **Content Standards and Objectives**
The Cell (1.0) • Cell structures and functions (1.1) • Differentiation of cells (1.2) • Specialized cells (1.3)
The Molecular Basis of Heredity (2.0) • DNA structure and function in heredity (2.1) • Sorting and recombination of genes (2.2)
Biological Diversity (3.0) • Variation among organisms (3.1) • Natural selection and biological adaptations (3.2) • Behavior patterns can be used to ensure reproductive success (3.3)
The Interdependence of Organisms (4.0) • Organisms both cooperate and compete (4.1) • Population dynamics (4.2)
Matter/Energy/Organization in Living Systems (5.0) • Complexity and organization used for survival (5.1) • Matter and energy flow in living and nonliving systems (5.2) • Earth cycles including abiotic and biotic factors (5.3)

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General Considerations

It is necessary to create test items that are reliable, fair, and targeted to the *Oklahoma C*^{3} standards listed on the following pages. There are some general considerations and procedures for effective item development. These considerations include, but are not limited to, the following:

1. Each test form contains items assessing all process/inquiry standards and content standards listed in the Test Blueprint for Biology I. In the *Oklahoma C*^{3} standards document, asterisks have been used to identify standards and objectives that must be assessed by the local school district.

2. Test items attempt to focus on content that is authentic and that end-of-instruction level students can relate to and understand.

3. Test items are worded precisely and clearly. The better focused an item, the more reliable and fair it is certain to be, and the more likely all students will understand what is required of them.

4. All items are reviewed to eliminate language that shows bias or is otherwise likely to disadvantage a particular group of students. That is, items do not display unfair representations of gender, race, disability, culture, or religion; nor do items contain elements that are offensive to any such groups.

5. All multiple-choice items (the key and all distractors) are similar in length and in syntax. Students should not be able to rule out a wrong answer or identify a correct response solely because it looks or sounds different from the other answer choices. Distractors are created so that students must reason their way to the correct answer rather than simply identify incorrect responses because of a distractor's obviously inappropriate nature. Distractors should always be plausible (but incorrect) in the context of the item stem. Correct responses will be approximately equally distributed among A's, B's, and C's.

Universal Design Considerations

Universal design, as applied to assessments, is a concept that allows the widest possible range of students to participate in assessments and may even reduce the need for accommodations and alternative assessments by expanding access to the tests themselves. In the Oklahoma Modified Alternate Assessment Program, modifications have been made to some items that simplify and clarify instructions, and provide maximum readability, comprehensibility, and legibility. This includes such things as reduction of language load in content areas other than Reading, increased font size, fewer items per page, and boxed items to assist visual focus.

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Oklahoma OMAAP Item Modifications

Universal Modifications

- Minimize the number of questions on the page (limit 2 or 3).
- Provide only three answer options instead of four.
- Highlight the main points in the question or passage by underlining and using bold font.
- Avoid questions that require students to select the better/best answer.
- Be consistent in wording of directions across grades and subjects.
- Minimize the use of pronouns and prepositional phrases.
- Avoid the use multiple meaning words and words that can function as more than part of speech.
- Enlarge art when possible.
- Simplify art when possible, (i.e. removing unnecessary labels, use less gray scale, use thicker lines when outlining, etc.).
- Box informational text in an item.
- Bullet information when possible (e.g. bullet detailed information or processes).
- Reduce reading load of stem, stimuli, and answer options when possible.
- Revise answer options to address parallelism and minimize outliers.

Science Items

- Reduce the amount of reading.
- Avoid complicated art.
- Simplify tables and charts by removing irrelevant rows or columns.
- Box formulas to make them stand out.
- Answer options align to content and process.
- Simplify reading load, including vocabulary, when possible.
- Eliminate stimuli sets.
- Delete cluster items, negative items, and items that cannot be modified based on guidelines.
- Delete extraneous information including irrelevant material and unnecessary words in items or graphics.
- Simplify complex sentence structure and vocabulary in item and answer choices without eliminating science vocabulary.
- Change passive voice to active voice when appropriate.
- Change item from an open-ended statement to a direct question or vice versa, as necessary, for clarification.
- Add precise language to provide additional context for clarification.
- Use consistent language within an item in order to focus student attention on what is being asked.
- Revise text as necessary to maintain the authenticity and logic of the item due to modifications.

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Oklahoma OMAAP Item Modifications
• Use bullets to clearly organize complex items into smaller, meaningful parts. • Direct student attention to graphics. • Simplify visual complexity of graphics. • Provide new text and/or reorganize existing text within the question to explain or clarify the graphic; science content must remain accurate. • Provide additional graphics to support text, emphasize ideas, and facilitate comprehension. • Reduce the number of variables and simplify digits in item when appropriate. • Limit the number of steps and/or operations in multi-step problems. • Provide appropriate formula and/or conversion near the item. • Avoid using items that reference x and y axis on a graph.

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Example of Item Modification

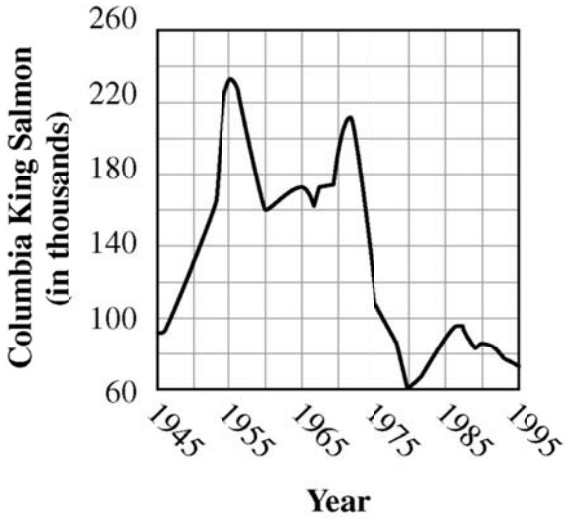
Original Item

A team of biologists studied how changes in climate affected the Columbia River king salmon population over a fifty-year period.

Climate Conditions in Columbia River Region, 1945–1995

Time Period	Temperature	Rainfall
1945–1955	Cool	High
1956–1965	Average	Average
1966–1975	Cool	High
1976–1985	Warm	Low
1986–1995	Average	Low

King Salmon Population of Columbia River



What were the climate conditions when the salmon population was lowest?

A cool temperatures and high rainfall
B warm temperatures and low rainfall
C average temperatures and low rainfall
D average temperatures and average rainfall

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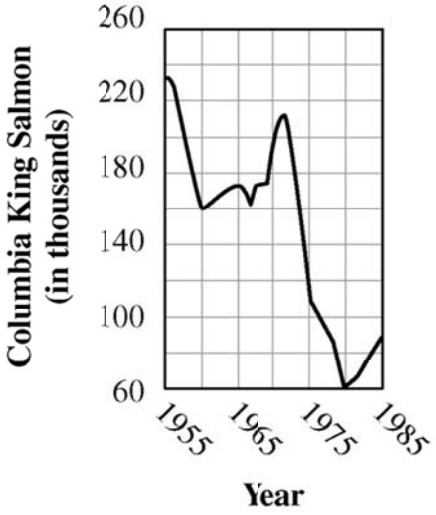
Modified Item

A team of biologists studied how changes in climate affected the Columbia River king salmon population over a 30-year period.

Climate Conditions in Columbia River Region, 1956–1985

Time Period	Temperature	Rainfall
1956–1965	Average	Average
1966–1975	Cool	High
1976–1985	Warm	Low

King Salmon Population of Columbia River



What were the climate conditions when the salmon population was lowest?

A cool temperatures and high rainfall
B warm temperatures and low rainfall
C average temperatures and low rainfall

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Multiple-Choice Item Rules

- All items clearly indicate what is expected in a response and help students focus on their response.

- Each multiple-choice item has a stem (question, statement, or incomplete statement and/or graphic component) and three answer (or completion) options, only one of which is correct.

- Multiple-choice item stems present a complete problem so that students know what to do before looking at the answer choices; students should not need to read all answer choices before knowing what is expected.

In summary, End-of-Instruction Biology I test items will assess whether students understand scientific methods and biological concepts.

All items developed using these specifications are reviewed by Oklahoma educators and approved by the Oklahoma State Department of Education. The distribution of newly developed or modified items is based on content and process alignment, difficulty, cognitive ability, percentage of art/graphics, and grade level appropriateness as determined by an annual Item Development Plan approved by the Oklahoma State Department of Education.

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Test Structure, Format, and Scoring

The test will consist of 46-49 operational multiple-choice items, which will be written at a reading level about three grade levels below an End-of-Instruction Biology I audience and will include three responses from which to choose: the correct answer and two distractors.

Each multiple-choice item is scored as correct or incorrect. The student's raw score is converted to a scaled score using the number-correct method.

Test Alignment

Criteria for Aligning the Test with Standards and Objectives
1. Categorical Concurrence The test is constructed so that there are at least six items measuring each *Oklahoma* C^3 standard, with the content category consistent with the related standard. The number of items, six, is based on estimating the number of items that could produce a reasonably reliable estimate of a student's mastery of the content measured.
2. Depth of Knowledge Consistency The test is constructed using items from a variety of depth-of-knowledge levels that are consistent with the processes students need in order to demonstrate proficiency for each *Oklahoma* C^3 objective.
3. Range of Knowledge Correspondence The test is constructed so that at least 50% of the objectives for an *Oklahoma* C^3 standard are assessed.
4. Balance of Representation The test is constructed according to the Test Blueprint, which reflects the degree of representation given on the test to each *Oklahoma* C^3 standard and objective in terms of the percent of total test items measuring each standard and the number of test items measuring each objective.
5. Source of Challenge Each test item is constructed in such a way that the major cognitive demand comes directly from the targeted *Oklahoma* C^3 skill or concept being assessed, not from specialized knowledge or cultural background that the test-taker may bring to the testing situation.

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Oklahoma School Testing Program
Oklahoma Modified Alternate Assessment Program
Biology I
Test Blue Print
School Year 2012–2013

The Test Blueprint reflects the degree to which each standard and objective is represented on the test. The overall distribution of operational items in a test form is intended to look as follows:

Process/Inquiry Standards and Objectives	Ideal Number of Items	Ideal Percentage of Items
Observe and Measure (P1.0)	**6**	**12%**
Qualitative/quantitative observations and changes (P1.1)	4	
Use appropriate System International (SI) units and tools (P1.2 & P1.3)	2	
Classify (P2.0)	**6**	**12%–13%**
Use observable properties to classify (P2.1)	2–4	
Identify properties of a classification system (P2.2)	2–4	
Experimental Design (P3.0)	**13–16**	**27%–32%**
Evaluate the design of investigations (P3.1)	3–4	
Identify a testable hypothesis, controlled variables, and experimental controls in an experiment (P3.2 & P3.4)	3–4	
Use mathematics to show relationships (P3.3)	3–4	
Identify potential hazards and practice safety procedures in all science activities (P3.5)	3–4	
Interpret and Communicate (P4.0)	**16–19**	**33%–39%**
Select predictions based on observed patterns of evidence (P4.1)	3–4	
Interpret line, bar, trend, and circle graphs (P4.3)	3–4	
Accept or reject a hypothesis (P4.4)	3	
Make logical conclusions based on experimental data (P4.5)	3–4	
Identify an appropriate graph or chart (P4.8)	3–4	
Model (P5.0)	**6**	**13%**
Interpret a model which explains a given set of observations (P5.1)	3	
Select predictions based on models using mathematics when appropriate (P5.2)	3	
Total Test	**46–49**[1]	**100%**

[1] The actual number of items scored for a student may be slightly lower pending a review of item statistics.

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Oklahoma School Testing Program
Oklahoma Modified Alternate Assessment Program
Biology I
Test Blue Print (continued)
School Year 2012-13

The Test Blueprint reflects the degree to which each standard and objective is represented on the test. The overall distribution of operational items in a test form is intended to look as follows:

Content Standards and Objectives	Ideal Number of Items	Ideal Percentage of Items[1]
The Cell (1.0)	**9–12**	**21%–27%**
Cell structures and functions (1.1)	3–5	
Differentiation of cells (1.2)	2–4	
Specialized cells (1.3)	2–4	
The Molecular Basis of Heredity (2.0)	**9–12**	**21%–27%**
DNA structure and function in heredity (2.1)	3–6	
Sorting and recombination of genes (2.2)	4–7	
Biological Diversity (3.0)	**9–12**	**21%–27%**
Variation among organisms (3.1)	2–4	
Natural selection and biological adaptations (3.2)	3–5	
Behavior patterns can be used to ensure reproductive success (3.3)	2–4	
The Interdependence of Organisms (4.0)	**6–8**	**14%–18%**
Organisms both cooperate and compete (4.1)	3–5	
Population dynamics (4.2)	3–5	
Matter/Energy/Organization in Living Systems (5.0)	**10**	**21%**
Complexity and organization used for survival (5.1)	3–4	
Matter and energy flow in living and nonliving systems (5.2)	3–4	
Earth cycles including abiotic and biotic factors (5.3)	3–4	
Total Test	**43–46[2]**	**100%**

[1] While the blueprint specifies an ideal percentage of items for the content standards, some variation in the number of items per standard/objective is allowable. The number of items per content standard/objective in a given test should fit within the range specified in the blueprint.
[2] Three out of the 46 total items assess the "Safety" process standard, for which there is no corresponding content standard.
• Student performance on the multiple-choice test will be reported at the standard level. A minimum of 6 items is required to report a standard. While the actual numbers of items on the test may not match the blueprint exactly, each future test will move toward closer alignment with the ideal blueprint.
• The approximate percentages are based on the total number of items on a test that are matched to the content standards and do not include items added for safety.
• Biology I *Oklahoma C*[3] Standards correspond to the *PASS* Biology I standard revision 2011.

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OVERVIEW OF ITEM SPECIFICATIONS

For each *Oklahoma C^3* standard, item specifications are organized under the following headings:

- *Oklahoma C^3* Standard and *Oklahoma C^3* Objective
- Item Specifications
  a. Emphasis
  b. Stimulus Attributes
  c. Format
  d. Assessment Limits
  e. Content/Process Objectives May Include
  f. Distractor Domain
  g. Sample Test Items

The headings "*Oklahoma C^3* Standard" and "*Oklahoma C^3* Objective" state the standard and objective being measured as found in the Biology I section of the *C^3* document.

The heading "Item Specifications" highlights important information about the item's development and provides examples to facilitate understanding. All items will measure one process objective and one content objective, with the exception of items for process objective 3.5, which measures safety only. All items will assess objectives using only depth-of-knowledge levels 1, 2, or 3.

Descriptions of the depth-of-knowledge levels for Biology I are as follows:

Level 1 is the recall of information such as a fact, definition, term, or a simple procedure, as well as performing a **simple** science process or procedure. Level 1 only requires students to demonstrate a rote response, use a well-known formula, follow a set procedure (like a recipe), or perform a clearly defined series of steps. A "simple" procedure is well-defined and typically involves only **one step**. Verbs such as "identify," "recall," "recognize," "use," "calculate," and "measure" generally represent cognitive work at the recall and reproduction level. Simple word problems that can be directly translated into and solved by a formula are considered Level 1. Verbs such as "describe" and "explain" could be classified at different depth-of-knowledge levels, depending on the complexity of what is to be described and explained.

A student answering a Level 1 item either knows the answer or does not: that is, the answer does not need to be "figured out" or "solved." In other words, if the knowledge necessary to answer an item automatically provides the answer to the item, then the item is at Level 1. If the knowledge necessary to answer the item does not automatically provide the answer, the item is at least at Level 2. Some examples that represent, but do not constitute all of, Level 1 performance are:

- Recall or recognize a fact, term, or property.
- Represent in words or diagrams a scientific concept or relationship.
- Provide or recognize a standard scientific representation for a simple phenomenon.
- Perform a routine procedure such as measuring length.

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Level 2 includes the engagement of some mental processing beyond recalling or reproducing a response. The content knowledge or process involved is **more complex** than in Level 1. Items require students to make some decisions as to how to approach the question or problem. Keywords that generally distinguish a Level 2 item include "classify," "organize," "estimate," "make observations," "collect and display data," and "compare data." These actions imply **more than one step**. For example, to compare data requires first identifying characteristics of the objects or phenomenon and then grouping or ordering the objects. Level 2 activities include making observations and collecting data; classifying, organizing, and comparing data; and organizing and displaying data in tables, graphs, and charts.

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

- Specify and explain the relationship between facts, terms, properties, or variables.
- Describe and explain examples and non-examples of science concepts.
- Select a procedure according to specified criteria and perform it.
- Formulate a routine problem given data and conditions.
- Organize, represent, and interpret data.

Level 3 requires reasoning, planning, using evidence, and a higher level of thinking than the previous two levels. The cognitive demands of Level 3 are **complex and abstract**. The complexity does not result only from the fact that there could be multiple answers, a possibility for both Levels 1 and 2, but because the multistep task requires **more demanding reasoning**. In most instances, requiring students to explain their thinking is at Level 3; requiring a very simple explanation or a word or two should be at Level 2. An activity that has more than one possible answer and requires students to justify the response they give would most likely be Level 3. Experimental designs in Level 3 typically involve more than one dependent variable. Other Level 3 activities include drawing conclusions from observations; citing evidence and developing a logical argument for concepts; explaining phenomena in terms of concepts; and using concepts to solve nonroutine problems.

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Depth of Knowledge Assessed by Test Items

The test will approximately reflect the following depth of knowledge distribution of items:

Depth of Knowledge	Percentage of Items
Level 1—Recall	20–25%
Level 2—Basic Reasoning	60–65%
Level 3—Complex and Extended Reasoning	10–15%

This is the ideal depth of knowledge distribution of items. There may be slight differences in the actual distribution of the upcoming testing session.

Note about the Item Specifications and Sample Items:

With the exception of content limits, the item specifications give suggestions of what might be included but do not give an exhaustive list of what can be included.

These sample test items are not intended to be definitive in nature or construction, as the stimuli and test items may differ from one test to another, as may their presentation.

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Oklahoma C^3 Standards

High School

Biology I

Asterisks (*) have been used to identify standards and objectives that must be assessed by the local school district. All other skills may be assessed by the Oklahoma School Testing Program (OSTP).

The *Oklahoma C*^{3} Standards should be taught by investigating content, concepts, and principles of major themes in the Biological Sciences.

SCIENCE PROCESSES AND INQUIRY

Process Standard 1: Observe and Measure – Observing is the first action taken by the learner to acquire new information about an organism or event. Opportunities for observation are developed through the use of a variety of scientific tools, allowing the student to distinguish between observation and inference. Measurement allows observations to be quantified. The student will accomplish these objectives to meet this process standard.

1. Identify qualitative and quantitative changes in cells, organisms, populations, and ecosystems given conditions (e.g., temperature, mass, volume, time, position, length, quantity) before, during, and after an event.
2. Use appropriate tools with accuracy and precision (e.g., microscope, pipette, metric ruler, graduated cylinder, thermometer, balance, stopwatch) when measuring cells, organisms, populations, and ecosystems.
3. Use appropriate International System of Units (SI) (i.e., grams, meters, liters, degrees Celsius, and seconds) and SI prefixes (i.e., micro-, milli-, centi-, and kilo-) when measuring objects and/or events.

Process Standard 2: Classify – Classifying establishes order. Organisms and events are classified based on similarities, differences, and interrelationships. The student will accomplish these objectives to meet this process standard.

1. Using observable properties, place cells, organisms, and/or events into a biological classification system (e.g., dichotomous keys, taxonomy charts, cladograms).
2. Identify the properties by which a biological classification system is based.

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Process Standard 3: Experimental Design – Understanding experimental design requires that students recognize the components of a valid experiment. The student will accomplish these objectives to meet this process standard.

1. Evaluate the design of a biology laboratory experiment.
2. Identify the independent variables, dependent variables, controlled variables, and control set-up in an experiment.
3. Use mathematics to show relationships within a given set of observations (e.g., population studies, biomass, probability).
4. Identify a hypothesis for a given problem in biology investigations.
5. Recognize potential hazards and practice safety procedures in all biology activities.

Process Standard 4: Interpret and Communicate – Interpreting is the process of recognizing patterns in collected data by making inferences, predictions, or conclusions. Communicating is the process of describing, recording, and reporting experimental procedures and results to others. Communication may be oral, written, or mathematical and includes organizing ideas, using appropriate vocabulary, graphs, other visual representations, and mathematical equations. The student will accomplish these objectives to meet this process standard.

1. Select appropriate predictions based on previously observed patterns of evidence.

*2. Report and display data using appropriate-technology and other media.

3. Interpret data tables, line, bar, trend, and/or circle graphs from existing science research or student experiments.
4. Determine if results of biological science investigations support or do not support hypotheses.
5. Evaluate experimental data to draw the conclusion that is best supported by the evidence.

*6. Routinely prepare a written report describing the sequence, results, and interpretation of a biological investigation or event.

   a. Establish and maintain a formal style and objective tone.
   b. When appropriate or possible, utilize technology to produce, publish, or revise writing products.
   c. Gather relevant information from multiple authoritative print and digital sources and follow a standard format for citation, avoiding plagiarism.

*7. Communicate or defend scientific thinking that results in conclusions.

   a. Read, comprehend, and present evidence from a range of sources (e.g., texts, experiments, or simulations) to support conclusions.
   b. Recognize bias in observation/research.

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8. Identify and/or create an appropriate graph or chart from collected data, tables, or written description (e.g., population studies, plant growth, heart rate).

   a. Translate quantitative information expressed in words into visual form (e.g., a table or chart).

   b. Translate information expressed visually or mathematically (e.g., a table, chart or equation) into words.

Process Standard 5: Model – Modeling is the active process of forming a mental or physical representation from data, patterns, or relationships to facilitate understanding and enhance prediction. The student will accomplish these objectives to meet this process standard.

1. Interpret a biological model which explains a given set of observations.
2. Select predictions based on models (e.g., pedigrees, life cycles), and when appropriate, apply mathematical reasoning to make accurate predictions.

*3. Compare a given model to the living world.

Process Standard 6: Inquiry – Inquiry can be defined as the skills necessary to carry out the process of scientific or systemic thinking. In order for inquiry to occur students must have the opportunity to make observation, pose questions, formulate testable hypotheses, carry out experiments, and make conclusions based on evidence. The student will accomplish these objectives to meet this process standard.

*1. Ask a scientific question, formulate a testable hypothesis, and design an appropriate experiment relating to the living world.

*2. Design and conduct biological investigations in which variables are identified and controlled.

*3. Use a variety of technologies (e.g., probes, handheld digital devices, electrophoresis equipment, digital cameras, software, calculators, digital balances, microscopes, measuring instruments, and computers) to collect, analyze and display data.

*4. Inquiries should lead to the formulation of explanations or models (physical, conceptual, and mathematical). In answering questions, students should engage in research and discussions (based on scientific knowledge, the use of logic, and evidence from the investigation) and arguments that encourage the revision of their explanations, leading to further inquiry.

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BIOLOGY I

High School

Standard 1: The Cell – Cells are the fundamental unit of life, composed of a variety of structures that perform functions necessary to maintain life. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Cells are composed of a variety of structures such as the nucleus, cell/plasma membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts.
    a. The cell/plasma membrane functions (i.e., active transport, passive transport, diffusion, osmosis, and surface area to volume ratio) to maintain homeostasis.
    b. Differentiate among hypotonic, hypertonic, and isotonic conditions.
    c. Compare and contrast prokaryotic and eukaryotic cells.
2. In multicellular organisms, cells have levels of organization (i.e., cells, tissues, organs, organ systems, organisms).
3. Specialized cells enable organisms to monitor what is going on in the world around them (e.g., detect light, sound, specific chemicals, gravity, plant tropism, sense organs, homeostasis).

Standard 2: The Molecular Basis of Heredity – DNA determines the characteristics of organisms. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Cells function according to the information contained in the master code of DNA (i.e., cell cycle, DNA replication and transcription). Transfer RNA and protein synthesis will be taught in life science courses with rigor greater than Biology I.
2. A sorting and recombination of genes during sexual reproduction results in a great variety of possible gene combinations from the offspring of any two parents (i.e., Punnett squares and pedigrees). Students will understand concepts in a single trait cross (e.g., alleles, dominant trait, recessive trait, phenotype, genotype, homozygous, heterozygous, incomplete dominance, and sex-linked traits).

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Standard 3: Biological Diversity – Diversity of species is developed through gradual processes over many generations. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Different species might look dissimilar, but the unity among organisms becomes apparent from an analysis of internal structures, the similarity of their chemical processes, and the evidence of common ancestry (e.g., homologous and analogous structures, embryology, fossil record, genetic data).
2. Characteristics of populations change through the mechanism of natural selection. These biological adaptations, including changes in structures, behaviors, and/or physiology, may enhance or limit survival and reproductive success within a particular environment.
3. Broad patterns of behavior exhibited by animals have changed over time to ensure reproductive success. Responses to external stimuli can result from interactions with the organism's own species and others, as well as environmental changes; these responses can be either innate or learned.

Standard 4: The Interdependence of Organisms – Interdependence of organisms in an environment includes the interrelationships and interactions between and among organisms. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. Organisms both cooperate and compete in ecosystems (e.g., symbiotic relationships).
2. Living organisms have the capacity to produce populations of infinite size, but environments and resources limit population size (e.g., carrying capacity, limiting factors, ecological succession).

Standard 5: Matter, Energy, and Organization in Living Systems – Living systems require a continuous input of energy to maintain their chemical and physical organizations. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

1. The complexity and organization of organisms accommodates the need for obtaining, transforming, transporting, releasing, and eliminating the matter and energy used to sustain the organism (i.e., photosynthesis and cellular respiration).
2. As matter and energy flow through different levels of organization of living systems and between living systems and the physical environment, chemical elements are recombined in different ways by different structures. Matter and energy are conserved in each change (i.e., water cycle, carbon cycle, nitrogen cycle, food webs, and energy pyramids).
3. Matter on earth cycles among the living (biotic) and nonliving (abiotic) components of the biosphere.

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***Oklahoma C³* Standard:**

Process Standard 1: Observe and Measure – Observing is the first action taken by the learner to acquire new information about an organism or event. Opportunities for observation are developed through the use of a variety of scientific tools, allowing the student to distinguish between observation and inference. Measurement allows observations to be quantified. The student will accomplish these objectives to meet this process standard.

***Oklahoma C³* Objective:**

Process Objective 1: Identify qualitative and quantitative changes in cells, organisms, populations, and ecosystems given conditions (e.g., temperature, mass, volume, time, position, length, quantity) before, during, and after an event.

Item Specifications:

Emphasis:

Make qualitative and quantitative observations. Identify the change that occurs over time or determine the cause of the change.

Stimulus Attributes:

Test items may include illustrations, charts, graphs, and tables.

Format:

Assessable content includes:

1. Students will apply observation skills in biological contexts.
2. Students will identify and differentiate qualitative and quantitative data or measurement collected within a research plan or experiment.
3. Students will determine which data (qualitative or quantitative) would be most appropriate to collect in order to test a hypothesis.
4. Students will identify and describe information collected from observation and measurement.
5. Students will identify observations and measurements which are precise, accurate, and reliable.

Item Content Limits:

Non-assessable content includes:

1. Items with measurements not listed in Process Standard 1.3.

Content Objectives May Include:

Items may be written to assess any of the content objectives.

Distractor Domain:

Incorrect qualitative or quantitative observations

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Modified *Oklahoma C³* Sample Item:
Process Objective: 1.1
Content Objective: 3.2
Depth of Knowledge: 2
Correct Answer: B

Parts of three different species of trees are shown below.

Which characteristic enables these species of trees to move into new areas quickly?

Ⓐ the number of leaves

Ⓑ the shape of the seeds

Ⓒ the length of the branches

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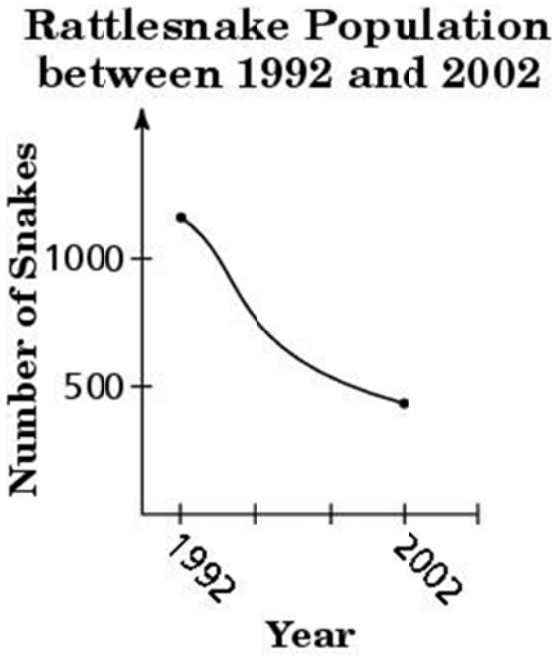
Modified *Oklahoma C³* Sample Item:
Process Objective: 1.1
Content Objective: 4.3
Depth of Knowledge: 2
Correct Answer: B

Scientists studied a rattlesnake population from 1992 through 2002. No snakes moved into or out of the area during this time.



Which of these <u>most likely</u> happened between 1992 and 2002?

Ⓐ The birth rate was equal to the death rate.

Ⓑ The birth rate was less than the death rate.

Ⓒ The birth rate was greater than the death rate.

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***Oklahoma C³* Standard:**

Process Standard 1: Observe and Measure – Observing is the first action taken by the learner to acquire new information about an organism or event. Opportunitites for observation are developed through the use of a variety of scientific tools, allowing the student to distinguish between observation and inference. Measurement allows observations to be quantified. The student will accomplish these objectives to meet this process standard.

***Oklahoma C³* Objective:**

Process Objective 2: Use appropriate tools with accuracy and precision (e.g., microscope, pipette, metric ruler, graduated cylinder, thermometer, balance, stopwatch) when measuring cells, organisms, populations, and ecosystems.

Item Specifications:

Emphasis:

Recognize and select appropriate tools when investigating cells, organisms, populations, and ecosystems.

Stimulus Attributes:

Test items may include illustrations and descriptions.

Format:

Assessable content includes:

1. Students will apply knowledge of tools commonly used in high school biology classrooms.
2. Students will identify correct methods for using measurement tools.
3. Students will use appropriate tools to make precise, accurate, and reliable measurements.

Item Content Limits:

Non-assessable content includes:

1. Items referencing measurement tools designed for use at the university or professional research level.

Content Objectives May Include:

Items may be written to assess any of the content objectives.

Distractor Domain:

1. Inappropriate tools for measurement
2. Incorrect methods for using tools

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Modified *Oklahoma C*^{3} Sample Item:
Process Objective: 1.2
Content Objective: 1.1
Depth of Knowledge: 1
Correct Answer: C

A scientist can view the site of photosynthesis in a plant cell by

Ⓐ using a magnifying glass to view the chloroplasts.

Ⓑ using a microscope to view the mitochondria.

Ⓒ using a microscope to view the chloroplasts.

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***Oklahoma C³* Standard:**

Process Standard 1: Observe and Measure – Observing is the first action taken by the learner to acquire new information about an organism or event. Opportunities for observation are developed through the use of a variety of scientific tools, allowing the student to distinguish between observation and inference. Measurement allows observations to be quantified. The student will accomplish these objectives to meet this process standard.

***Oklahoma C³* Objective:**

Process Objective 3: Use appropriate International System of Units (SI) (i.e., grams, meters, liters, degrees Celsius, and seconds) and SI prefixes (i.e., micro-, milli-, centi-, and kilo-) when measuring objects and/or events.

Item Specifications:

Emphasis:

Recognize and select appropriate units when investigating cells, organisms, populations, and ecosystems.

Stimulus Attributes:

Test items may include illustrations and descriptions.

Format:

Assessable content includes:

1. Students will apply knowledge of System International units and/or prefixes in biological contexts.
2. Students will determine which unit of measurement would be most appropriate to use in data collection
3. Students will identify derived units for quantities found in biological context (i.e., population density, surface area/volume, rate, concentration).

Item Content Limits:

Non-Assessable content includes:

1. Items referencing units or prefixes other than SI.
2. Items with derived units other than those listed in #3 above.

Content Objectives May Include:

Items may be written to assess any of the content objectives.

Distractor Domain:

Inappropriate SI units and prefixes

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Modified *Oklahoma C³* Sample Item:
Process Objective: 1.3
Content Objective: 1.2
Depth of Knowledge: 2
Correct Answer: C

Which measurement units best describe the comparison of cell size to organ size?

Ⓐ meters to millimeters

Ⓑ centimeters to meters

Ⓒ micrometers to centimeters

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***Oklahoma C³* Standard:**

Process Standard 2: Classify – Classifying establishes order. Organisms and events are classified based on similarities, differences, and interrelationships. The student will accomplish these objectives to meet this process standard.

***Oklahoma C³* Objective:**

Process Objective 1: Using observable properties, place cells, organisms, and/or events into a biological classification system (e.g., dichotomous keys, taxonomy charts, cladograms).

Item Specifications:

Emphasis:

Apply classification skills based on observations using a variety of simple classification systems.

Stimulus Attributes:

Items may include illustrations, classification keys, including dichotomous keys, data tables, behavioral checklists, flowcharts, life cycles, and cladograms.

Format:

Assessable content includes:

1. Students will use observable characteristics to apply classification skills in biological contexts.
2. Students will accurately utilize a variety of classification systems (e.g., dichotomous keys, taxonomy charts, cladograms

Item Content Limits:

Non-assessable content includes:

1. Obscure classification systems.
2. Items requiring identification of the best classification system based on a given set of properties.

Content Objectives May Include:

Items may be written to assess any of the content objectives.

Distractor Domain:

Inappropriate classifications

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Modified *Oklahoma C³* Sample Item:
Process Objective: 2.1
Content Objective: 3.1
Depth of Knowledge: 2
Correct Answer: C

DNA of Three Organisms

Organism	Same Segment of DNA
1	AAA CGG TAC AAA
2	ATT GCG TAA AAA
3	AAA CGG TAA AAA

Which organisms are most closely related?

Ⓐ organisms 1 and 2

Ⓑ organisms 2 and 3

Ⓒ organisms 1 and 3

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***Oklahoma C³* Standard:**

Process Standard 2: Classify – Classifying establishes order. Organisms and events are classified based on similarities, differences, and interrelationships. The student will accomplish these objectives to meet this process standard.

***Oklahoma C³* Objective:**

Process Objective 2: Identify the properties by which a biological classification system is based.

Item Specifications:

Emphasis:

Understand a classification system and identify the observable properties used for classifying.

Stimulus Attributes:

Items may include illustrations, Venn diagrams, classification keys, including dichotomous keys, data tables, behavioral checklists, and cladograms.

Format:

Assessable content includes:

1. Students will apply classification skills in biological contexts.
2. Students will identify and apply understanding of properties that are relevant to particular classification systems common to biological sciences (e.g. behavior, structural similarities/differences, and genetics).

Item Content Limits:

Non-assessable content includes:

1. Classification based on Gram positive/negative
2. Information outside the contextual level of Biology I.

Content Objectives May Include:

Items may be written to assess any of the content objectives.

Distractor Domain:

Properties that are inappropriate for the given classification system

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Modified *Oklahoma C³* Sample Item:
Process Objective: 2.2
Content Objective: 3.1
Depth of Knowledge: 2
Correct Answer: B

Scientists have classified the reticulated giraffe and the mountain goat as the most closely related animals in the table.

Characteristics of Four Animals

Organism	Native Range	Number of Toes	Most Active Day or Night?
Mountain Goat	North America	2	Day
Grevy's Zebra	Africa	1	Day
Reticulated Giraffe	Africa	2	Day
Asian Elephant	Asia	3 to 5	Day

Which property <u>best</u> supports the classification of the reticulated giraffe and the mountain goat?

Ⓐ the native range

Ⓑ the number of toes

Ⓒ the time they are most active

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Modified *Oklahoma C*^{3} Sample Item:
Process Objective: 2.2
Content Objective: 6.2
Depth of Knowledge: 2
Correct Answer: B

Female hanging flies require their male mates to bring them a gift, such as a moth, to eat. Female hanging flies raised in isolation from adults also require a gift from their mates.

Which statement is the best explanation for this behavior?

Ⓐ The behavior is learned.

Ⓑ The behavior is inherited.

Ⓒ The behavior is acquired randomly.

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***Oklahoma C³* Standard:**

Process Standard 3: Experimental Design – Understanding experimental design requires that students recognize the components of a valid experiment. The student will accomplish these objectives to meet this process standard.

***Oklahoma C³* Objective:**

Process Objective 1: Evaluate the design of a biology laboratory experiment.

Item Specifications:

Emphasis:

Sequence steps in logical progression; determine what steps are not needed or have been left out; and/or identify correct and incorrect scientific procedures.

Stimulus Attributes:

Items will include a scenario of an experimental design and may include illustrations, tables, and graphs.

Format:

Assessable content includes:

1. Students will be able to critique a research plan and/or experiment.
2. Students will determine which data (qualitative or quantitative) would be most appropriate to collect for a research plan or experiment.
3. Students will determine which data (qualitative or quantitative) would be most appropriate to collect in order to test a hypothesis.
4. Students will determine the appropriate tools in experimental protocol that will generate valid data.
5. Students will distinguish observation from inference.
6. Students will identify investigatable/non-investigatable questions in relation to experimental design.
7. Students will understand how to insure accuracy, precision, and reliability in a science experiment (e.g. multiple trials, repeatability, internal consistency, sampling size)

Item Content Limits:

Non-assessable content includes:

1. Null hypothesis
2. Identifying bias

Content Objectives May Include:

Items may be written to assess any of the content objectives.

Distractor Domain:

1. Steps listed in an incorrect order
2. Steps not needed in an experiment
3. Necessary steps for an experiment
4. Inappropriate experiment procedures

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Modified *Oklahoma* C^3 Sample Item:
Process Objective: 3.1
Content Objective: 6.1
Depth of Knowledge: 2
Correct Answer: C

Anita wants to test whether soaking seeds in water affects the sprouting process.

Which should Anita measure to get the most useful results?

Ⓐ growth of 100 soaked seeds

Ⓑ growth of 100 non-soaked seeds

Ⓒ growth of 100 soaked seeds and 100 non-soaked seeds

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***Oklahoma C³* Standard:**

Process Standard 3: Experimental Design – Understanding experimental design requires that students recognize the components of a valid experiment. The student will accomplish these objectives to meet this process standard.

***Oklahoma C³* Objective:**

Process Objective 2: Identify the independent variables, dependent variables, controlled variables, and control set-up in an experiment.

Item Specifications:

Emphasis:

Know the terms and be able to identify them in an experimental design: independent variable, dependent variable, control group, and controlled variables.

Stimulus Attributes:

Items will include a scenario of an experimental design and may include illustrations, tables, and graphs.

Format:

Assessable content includes:

1. Students will identify independent variables, dependent variables, and control variables within a controlled experiment.
2. Students will select independent variables, dependent variables, and control variables appropriate for a given set of data.
3. Students will select the most appropriate independent variable or dependent variable or control variable for use within a given controlled experiment.

Item Content Limits:

Non-assessable content includes:

1. Multiple independent variables

Content Objectives May Include:

Items may be written to assess any of the content objectives.

Distractor Domain:

Irrelevant variables and wrong types of variables and inconsistent constants

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Modified *Oklahoma* C^3 Sample Item:
Process Objective: 3.2
Content Objective: 5.2
Depth of Knowledge: 2
Correct Answer: A

A student designed an experiment to show the relationship between photosynthesis and cellular respiration. Four test tubes were sealed and left under lamp light for 24 hours.

Experimental Design

Test Tube 1	Test Tube 2	Test Tube 3	Test Tube 4
Water	Water	Water	Water
Plant	Plant	Snail	
Snail			

What was the role of Test Tube 4 in this experiment?

Ⓐ It was the control.

Ⓑ It was the variable.

Ⓒ It was an extra test tube.

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***Oklahoma C³* Standard:**

Process Standard 3: Experimental Design – Understanding experimental design requires that students recognize the components of a valid experiment. The student will accomplish these objectives to meet this process standard.

***Oklahoma C³* Objective:**

Process Objective 3: Use mathematics to show relationships within a given set of observations (e.g., population studies, biomass, probability).

Item Specifications:

Emphasis:

Apply mathematics to describe observations, infer relationships, and make predictions.

Stimulus Attributes:

Items may include descriptions, illustrations, data tables, graphs, and diagrams.

Format:

Assessable content includes:

1. Students will apply mathematics in biological contexts.
2. Students will apply mathematics in order to collect data and report data.
3. Students will correctly apply appropriate mathematical reasoning to explain science concepts: density (population density including exponential growth), percentage of growth increase/decrease, ratios (surface area/volume), rate of change, biomass, probability, percentages, fractions/decimals, genetic crosses (Punnett squares), calculating averages, and predicting energy flow in pyramids.
4. Students will select from a variety of data tables, line, bar, trend, and/or circle graphs the correct representation of data based upon mathematical calculations.

Item Content Limits:

Non-assessable content includes:

1. Conversion from English standard units of measurement to metric units of measurement.
2. Mathematics beyond the Algebra 1 level.

Content Objectives May Include:

Items may be written to assess any of the content objectives.

Distractor Domain:

1. Errors in calculation
2. Misconceptions

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Modified *Oklahoma* C^3 Sample Item:
Process Objective: 3.3
Content Objective: 5.2
Depth of Knowledge: 1
Correct Answer: B

Which statement about energy in an ecosystem is correct?

Ⓐ Primary consumers store about 10% of the energy in an ecosystem.

Ⓑ Producers transfer about 10% of their energy to primary consumers.

Ⓒ Primary consumers transfer 90% of their energy to secondary consumers.

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***Oklahoma C³* Standard:**

Process Standard 3: Experimental Design – Understanding experimental design requires that students recognize the components of a valid experiment. The student will accomplish these objectives to meet this process standard.

***Oklahoma C³* Objective:**

Process Objective 4: Identify a hypothesis for a given problem in biology investigations.

Item Specifications:

Emphasis:

Given an experimental design, identify an appropriate hypothesis.

Stimulus Attributes:

Items will include a scenario of a scientific problem or experimental design. Items may include illustrations, tables, and graphs.

Format:

Assessable content includes:

1. Students will identify the best possible solution as the hypothesis in a biological investigation (limited to if/then statements).

Item Content Limits:

Non-assessable content includes:

1. Null hypothesis.

Content Objectives May Include:

Items may be written to assess any of the content objectives.

Distractor Domain:

Distractors must be stated as a hypothesis but include incorrect variables

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Modified *Oklahoma C³* Sample Item:
Process Objective: 3.4
Content Objective: 5.1
Depth of Knowledge: 2
Correct Answer: B

Latosha performed an experiment on four equal-sized tomato plants. She gave each plant the same amount of light and nutrients, but different amounts of water. She frequently measured the amount of oxygen produced by each plant.

Which hypothesis is Latosha most likely studying in this experiment?

Ⓐ If the amount of light is increased, the rate of photosynthesis will increase.

Ⓑ If the amount of water is increased, the rate of photosynthesis will increase.

Ⓒ If the amount of nutrients is increased, the rate of photosynthesis will increase.

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***Oklahoma C³* Standard:**

Process Standard 3: Experimental Design – Understanding experimental design requires that students recognize the components of a valid experiment. The student will accomplish these objectives to meet this process standard.

***Oklahoma C³* Objective:**

Process Objective 5: Recognize potential hazards and practice safety procedures in all biology activities.

Item Specifications:

Emphasis:

Identify potential hazards in all biology activities. Be aware of unsafe practices and appropriate procedures in all biology-related activities conducted in the laboratory and/or the field.

Stimulus Attributes:

Test items may include illustrations, Material Safety Data sheets, safety symbols, and verbal descriptions.

Format:

Assessable content includes:

1. Students will identify and apply safety regulations in a laboratory setting.
2. Students will recognize commonly used laboratory safety symbols.
3. Students will recognize safety hazards and the procedures in which to make the situation safe.
4. Students will apply crisis management strategies as a reaction to a safety violation.
5. Students will evaluate and critique an experiment for safety consideration.

Item Content Limits:

Non-assessable content includes:

1. Non-standard symbols.
2. Interpretation of the safety diamond.

Content Objectives May Include:

Items for this objective test safety only. They do not assess content knowledge.

Distractor Domain:

1. Wrong safety hazard
2. Not a safety concern
3. Wrong safety procedure
4. Not a safety procedure

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Modified *Oklahoma C³* Sample Item:

Process Objective: 3.5
Content Objective: None
Depth of Knowledge: 1
Correct Answer: C

Joel finished an experiment and had some unused chemical solution.

What should Joel do with the extra solution?

Ⓐ pour it down the sink

Ⓑ pour it back into its original container

Ⓒ dispose of it as directed by his teacher

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***Oklahoma C³* Standard:**

Process Standard 4: Interpret and Communicate – Interpreting is the process of recognizing patterns in collected data by making inferences, predictions, or conclusions. Communicating is the process of describing, recording, and reporting experimental procedures and results to others. Communication may be oral, written, or mathematical and includes organizing ideas, using appropriate vocabulary, graphs, other visual representations, and mathematical equations. The student will accomplish these objectives to meet this process standard.

***Oklahoma C³* Objective:**

Process Objective 1: Select appropriate predictions based on previously observed patterns of evidence.

Item Specifications:

Emphasis:

Identify correct predictions based on patterns of evidence within given data.

Stimulus Attributes:

Data will be presented in tables, graphs, diagrams, illustrations, Venn diagrams, and descriptions.

Format:

Assessable content includes:

1. Students will accurately interpret information provided in order to make a prediction.
2. Students will detect patterns in evidence in order to make a prediction in biological contexts.
3. Students will make logical predictions linked to investigative procedures and available data.

Item Content Limits:

Non-assessable content includes:

1. More than three sets of data.
2. Content outside biological contexts.

Content Objectives May Include:

Items may be written to assess any of the content objectives.

Distractor Domain:

1. Wrong predictions
2. Predictions based on incorrect patterns

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Modified *Oklahoma C³* Sample Item:
Process Objective: 4.1
Content Objective: 2.2
Depth of Knowledge: 2
Correct Answer: A

In a species of wildflower, some plants produce red flowers while others produce white flowers. In a cross between two red wildflowers, 75% of the offspring produced red flowers and 25% produced white flowers.

RR = red flowers
Rr = red flowers
rr = white flowers

	R	r
R	RR	Rr
r	Rr	rr

If two wildflower plants with white flowers were crossed, which percentage of their offspring most likely would produce red flowers?

Ⓐ 0%

Ⓑ 50%

Ⓒ 75%

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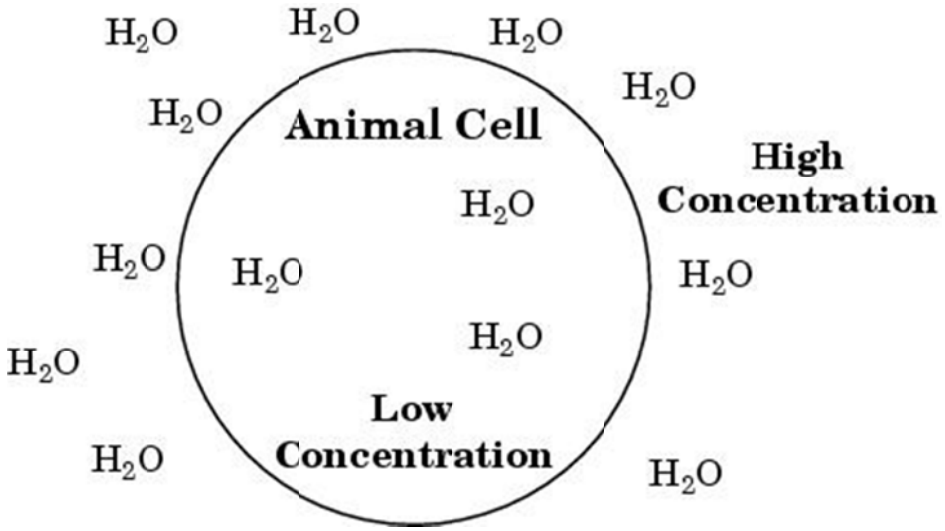
Modified *Oklahoma C³* Sample Item:
Process Objective: 4.1
Content Objective: 1.1
Depth of Knowledge: 2
Correct Answer: A

The figure below shows an animal cell placed in distilled water.



What will most likely happen to the animal cell?

Ⓐ More water will move into the cell than out of the cell.

Ⓑ More water will move out of the cell than into the cell.

Ⓒ The same amount of water will move into and out of the cell.

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***Oklahoma C³* Standard:**

Process Standard 4: Interpret and Communicate – Interpreting is the process of recognizing patterns in collected data by making inferences, predictions, or conclusions. Communicating is the process of describing, recording, and reporting experimental procedures and results to others. Communication may be oral, written, or mathematical and includes organizing ideas, using appropriate vocabulary, graphs, other visual representations, and mathematical equations. The student will accomplish these objectives to meet this process standard.

***Oklahoma C³* Objective:**

Process Objective 3: Interpret data tables, line, bar, trend, and/or circle graphs from existing science research or student experiments.

Item Specifications:

Emphasis:

Analyze information given in a simple data table, line, (e.g. broken line graph, multiple line graph, multiple labels on graph), bar, trend, or circle graph.

Stimulus Attributes:

Test items may include simple data tables, line, bar, trend, and/or circle graphs.

Format:

Assessable content includes:

1. Students will interpret simple data tables and graphs that communicate biological information.
2. Students will identify and interpret trends in a graph and/or data tables.
3. Students will distinguish relationships between two multiple data sets (e.g. direct, inverse).

Item Content Limits:

Non-assessable content includes:

1. Illustrations other than data tables or graph

Content Objectives May Include:

Items may be written to assesss any of the content objectives.

Distractor Domain:

1. Quantitative errors due to incorrect interpretations of table or graph
2. Qualitative errors due to incorrect interpretations of table or graph

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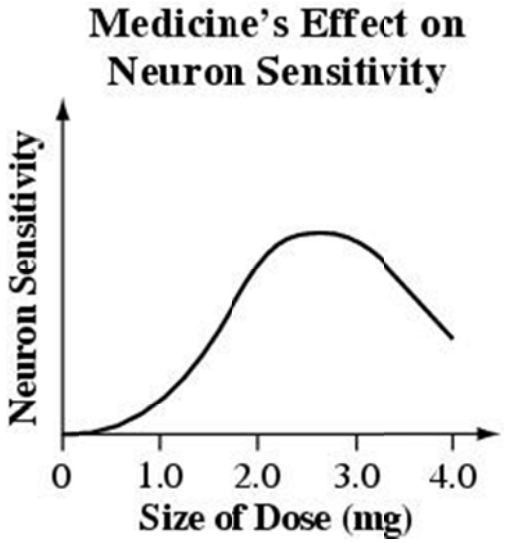
Modified *Oklahoma C³* Sample Item:
Process Objective: 4.3
Content Objective: 6.1
Depth of Knowledge: 2
Correct Answer: C

Doctors are studying the effectiveness of a medicine. This medicine increases the sensitivity of neurons to stimuli.



Which dose size of the medicine will begin to decrease the sensitivity of the neurons?

Ⓐ 0.5 mg/dose

Ⓑ 1.0 mg/dose

Ⓒ 3.0 mg/dose

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***Oklahoma C³* Standard:**

Process Standard 4: Interpret and Communicate – Interpreting is the process of recognizing patterns in collected data by making inferences, predictions, or conclusions. Communicating is the process of describing, recording, and reporting experimental procedures and results to others. Communication may be oral, written, or mathematical and includes organizing ideas, using appropriate vocabulary, graphs, other visual representations, and mathematical equations. The student will accomplish these objectives to meet this process standard.

***Oklahoma C³* Objective:**

Process Objective 4: Determine if results of biological science investigations support or do not support hypotheses.

Item Specifications:

Emphasis:

Analyze data to accept or reject a hypothesis for a biological investigation.

Stimulus Attributes:

The hypothesis will be stated as an "if, then" statement. Test items may include simple data in the form of illustrations, descriptions, tables, line, bar, trend, and/or circle graphs. Scenarios describing experimental design may be included.

Format:

Assessable content includes:

1. Students will analyze data or experimental scenarios to accept or reject a hypothesis (the best possible solution) for a biological investigation.
2. Identify an acceptable hypothesis from a given set of qualitative or quantitative data.
3. Select the data set that supports a given hypothesis.

Item Content Limits:

Non-assessable content includes:

1. Null hypothesis

Content Objectives May Include:

Items may be written to assess any of the content objectives.

Distractor Domain:

1. Results that do not support hypothesis
2. Results that do support hypothesis
3. Misconceptions

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Modified *Oklahoma C³* Sample Item:
Process Objective: 4.4
Content Objective: 3.2
Depth of Knowledge: 2
Correct Answer: A

A biologist is studying a species of crab. He hypothesized that if a crab has large pincer claws, then it will have greater reproductive success. He placed 50 crabs with small pincers and 50 crabs with large pincers together in an isolated area. He observed several generations over the next 10 years.

If his hypothesis is correct, which result would he most likely observe?

Ⓐ The percent of crabs with large pincers would increase.

Ⓑ The percent of crabs with small pincers would increase.

Ⓒ The percent of crabs with medium pincers would increase.

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***Oklahoma C³* Standard:**

Process Standard 4: Interpret and Communicate – Interpreting is the process of recognizing patterns in collected data by making inferences, predictions, or conclusions. Communicating is the process of describing, recording, and reporting experimental procedures and results to others. Communication may be oral, written, or mathematical and includes organizing ideas, using appropriate vocabulary, graphs, other visual representations, and mathematical equations. The student will accomplish these objectives to meet this process standard.

***Oklahoma C³* Objective:**

Process Objective 5: Evaluate experimental data to draw the conclusion that is best supported by the evidence.

Item Specifications:

Emphasis:

Given experimental data, students will analyze relevant data and draw an appropriate conclusion.

Stimulus Attributes:

Test items will include data which may be in the form of simple data tables, line, bar, trend, and/or circle graphs, and possibly supported by illustrations. Test stems may not include irrelevant data.

Format:

Assessable content includes:

1. Students will apply basic biological concepts and process skills to draw logical conclusion of experimental data.
2. Students will identify a research question based on a stated experimental conclusion.
3. Students will identify relevant data that supports a given conclusion.
4. Students will analyze multiple no more then two data sets from one biological investigation to formulate a valid conclusion.

Item Content Limits:

Non-assessable content includes:

1. Analysis of data from more than one biological investigation to formulate a valid conclusion.

Content Objectives May Include:

Items may be written to assess any of the content objectives.

Distractor Domain:

1. Inappropriate conclusions
2. Use of irrelevant data
3. Misconceptions of biological concepts

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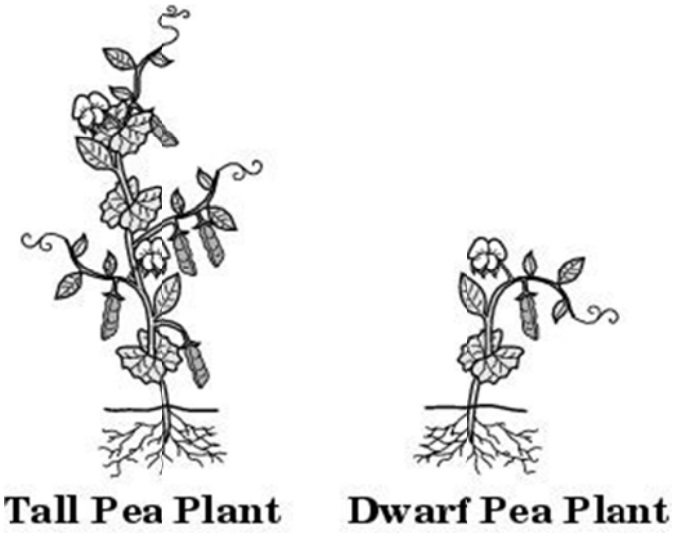
Modified *Oklahoma C³* Sample Item:
Process Objective: 4.5
Content Objective: 2.2
Depth of Knowledge: 2
Correct Answer: C

A student crossed a tall pure-breeding (homozygous) pea plant with a dwarf pure-breeding (homozygous) pea plant. All of the seeds grew into tall pea plants.



How should the student interpret the results of her experiment?

Ⓐ Tall stem height is recessive to dwarf stem height in pea plants.

Ⓑ Dwarf stem height is dominant to tall stem height in pea plants.

Ⓒ Tall stem height is dominant to dwarf stem height in pea plants.

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Oklahoma C3 Standard:

Process Standard 4: Interpret and Communicate – Interpreting is the process of recognizing patterns in collected data by making inferences, predictions or conclusions. Communicating is the process of describing, recording, and reporting experimental procedures and results to others. Communication may be oral, written, or mathematical and includes organizing ideas, using appropriate vocabulary, graphs, other visual representations, and mathematical equations. The student will accomplish these objectives to meet this process standard.

***Oklahoma C^3* Objective:**

Process Objective 8: Identify and/or create an appropriate graph or chart from collected data tables, or written description (e.g., population studies, plant growth, heart rate).

Item Specifications:

Emphasis:

Select an appropriate graph that represents data correctly.

Stimulus Attributes:

Test items may include charts, Venn diagrams, line, bar, and/or circle graphs.

Format:

Assessable content includes:

1. Students will identify the appropriate type of chart, graph, or Venn diagram that correctly represents data or trends.
2. Using a specific type of chart, graph, or Venn diagram, students will determine which graphic would most appropriately represent a given set of data (qualitative or quantitative).
3. Students will identify the appropriate data represented by a given chart, graph, or Venn diagram.

Item Content Limits:

Non-assessable content includes:

1. Graphs and diagrams not listed above.
2. Graphs with error bars.

Content Objectives May Include:

Items may be written to assess any of the content objectives.

Distractor Domain:

1. Incorrect type of graph Data incorrectly represented
2. Selection of incorrect variables
3. Incorrect placement of the independent and dependent variables on the axes
4. Incorrect units of measure

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***Oklahoma C³* Standard:**

Process Standard 4: Interpret and Communicate – Interpreting is the process of recognizing patterns in collected data by making inferences, predictions, or conclusions. Communicating is the process of describing, recording, and reporting experimental procedures and results to others. Communication may be oral, written, or mathematical and includes organizing ideas, using appropriate vocabulary, graphs, other visual representations, and mathematical equations. The student will accomplish these objectives to meet this process standard.

***Oklahoma C³* Objective:**

Process Objective 8: Identify and/or create an appropriate graph or chart from collected data, tables, or written description (e.g., population studies, plant growth, heart rate).

Process Skill 8a: Translate quantitative information expressed in words into visual form (e.g., a table or chart).

Item Specifications:

Emphasis:

Select an appropriate graph that represents data correctly.

Stimulus Attributes:

Test items may include charts, Venn diagrams, line, bar, and/or circle graphs.

Format:

Assessable content includes:

1. Students will identify the appropriate type of chart, graph, or Venn diagram that correctly represents data or trends.
2. Using a specific type of chart, graph, or Venn diagram, students will determine which graphic would most appropriately represent a given set of data (qualitative or quantitative).
3. Students will identify the appropriate data represented by a given chart, graph, or Venn diagram.

Item Content Limits:

Non-assessable content includes:

1. Graphs and diagrams not listed above.
2. Graphs with error bars.

Content Objectives May Include:

Items may be written to assess any of the content objectives.

Distractor Domain:

1. Incorrect type of graph Data incorrectly represented
2. Selection of incorrect variables
3. Incorrect placement of the independent and dependent variables on the axes
4. Incorrect units of measure

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***Oklahoma C³* Standard:**

Process Standard 4: Interpret and Communicate – Interpreting is the process of recognizing patterns in collected data by making inferences, predicting, or conclusions. Communicating is the process of describing recording, and reporting experimental procedures and results to others. Communication may be oral, written, or mathematical and includes organizing ideas, using appropriate vocabulary, graphs, other visual representations, and mathematical equations. The student will accomplish these objectives to meet this process standard.

***Oklahoma C³* Objective:**

Process Objective 8: Identify and/or create an appropriate graph or chart from collected data, tables, or written description (e.g., population studies, plant growth, heart rate).

Process Skill 4.8b: Translate information expressed visually or mathematically (e.g., a table, chart or equation) into words.

Item Specifications:

Emphasis:

Select an appropriate graph that represents data correctly.

Stimulus Attributes:

Test items may include charts, Venn diagrams, line, bar, and/or circle graphs.

Format:

Assessable content includes:

1. Students will identify the appropriate type of chart, graph, or Venn diagram that correctly represents data or trends.
2. Using a specific type of chart, graph, or Venn diagram, students will determine which graphic would most appropriately represent a given set of data (qualitative or quantitative).
3. Students will identify the appropriate data represented by a given chart, graph, or Venn diagram.

Item Content Limits

Non-assessable content includes:

1. Graphs and diagrams not listed above.
2. Graphs with error bars.

Content Objectives May Include:

Items may be written to assess any of the content objectives.

Distractor Domain:

1. Incorrect type of graph Data incorrectly represented
2. Selection of incorrect variables
3. Incorrect placement of the independent and dependent variables on the axes
4. Incorrect units of measure

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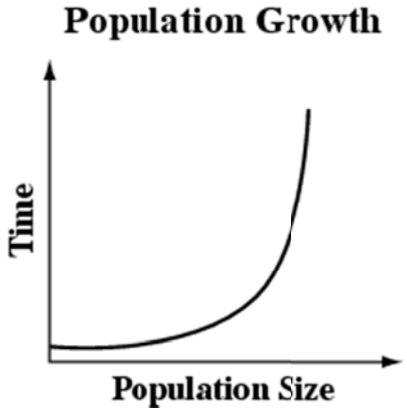
<u>Modified *Oklahoma C*[3] Sample Item:</u>
Process Objective: 4.8
Content Objective: 4.3
Depth of Knowledge: 1
Correct Answer: B

Which graph correctly illustrates the growth of a population with unlimited resources?

Ⓐ

Ⓑ

Ⓒ


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***Oklahoma C³* Standard:**

Process Standard 5: Model – Modeling is the active process of forming a mental or phycial representation from data, patterns, or relationships to facilitate understanding and enhance prediction. The student will accomplish these objectives to meet this process standard.

***Oklahoma C³* Objective:**

Process Objective 1: Interpret a biological model which explains a given set of observations.

Item Specifications:

Emphasis:

Comprehend a biological model, explain its elements and processes, describe relationships within it, and analyze and evaluate the model.

Stimulus Attributes:

Items will include illustrations of biological systems (e.g. life cycles, biogeochemical cycles, flow charts, food chains, food webs, DNA model, cell cycle, pedigrees, ecological succession).

Format:

Assessable content includes:

1. Students will accurately interpret or evaluate biological models.
2. Students will identify the advantages or limitations of a biological model.
3. Students will identify the best model based on given data.
4. Students will compare a model to the living world.

Item Content Limits:

Non-assessable content includes:

1. The names and events of each stage of mitosis or meiosis and the correct sequence of each.

Content Objectives May Include:

Items may be written to assess any of the content objectives.

Distractor Domain:

1. Inaccurate interpretations of models
2. Common misconceptions

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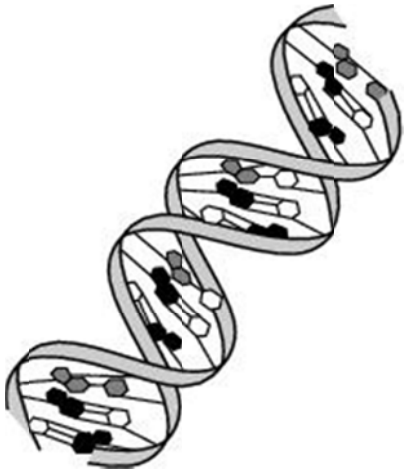
<u>Modified *Oklahoma C*^{3} Sample Item:</u>
Process Objective: 5.1
Content Objective: 2.1
Depth of Knowledge: 1
Correct Answer: C



What does the diagram represent?

Ⓐ the molecule that provides energy to a cell

Ⓑ the molecule that carries oxygen in the blood

Ⓒ the molecule that contains genetic information

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***Oklahoma C³* Standard:**

Process Standard 5: Model – Modeling is the active process of forming a mental or physical representation from data, patterns, or relationships to facilitate understanding and enhance prediction. The student will accomplish these objectives to meet this process standard.

***Oklahoma C³* Objective:**

Process Objective 2: Select predictions based on models (e.g., pedigrees, life cycles), and when appropriate, apply mathematical reasoning to make accurate predictions.

Item Specifications:

Emphasis:

Make predictions based on the analysis of a biological model.

Stimulus Attributes:

Items will include illustrations of biological systems. Items may include life cycles, nutrient cycles, flow charts, food chains, food webs, DNA model, cell cycle, pedigrees, ecological succession, etc.

Format:

Assessable content includes:

1. Students will analyze biological models and make predictions based upon their analyses.
2. Students will correctly apply appropriate mathematical reasoning to make accurate predictions based on a biological model (i.e., population density, percentage of growth increase/decrease, ratios (surface area/volume), biomass, probability, percentages, fractions/decimals, genetic crosses (Punnett squares), calculating averages, and predicting energy flow in pyramids).
3. Students will predict future outcomes as well as draw conclusions about what most likely happened in the past based on biological models.

Item Content Limits:

Non-assessable content includes:

1. Names and events of each stage of mitosis or meiosis and the correct sequence of each.

Content Objectives May Include:

Items may be written to assess any of the content objectives.

Distractor Domain:

1. Inaccurate predictions
2. Inaccurate calculation
3. Common misconceptions

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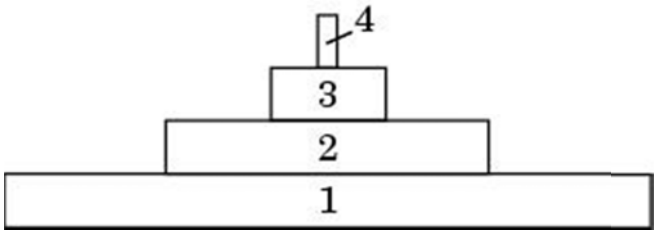
Modified *Oklahoma C³* Sample Item:
Process Objective: 5.2
Content Objective: 5.2
Depth of Knowledge: 2
Correct Answer: A

The diagram below is an energy pyramid that groups the organisms of an ecosystem into four levels.



What will happen to the energy in level 2 of the pyramid?

Ⓐ Most of it will be lost to the environment.

Ⓑ Most of it will be passed to the level above it.

Ⓒ Most of it will be passed to the level below it.

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***Oklahoma C³* Standard:**

Content Standard 1: The Cell – Cells are the fundamental unit of life, composed of a variety of structures that perform functions necessary to maintain life. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

***Oklahoma C³* Objective:**

Content Objective 1: Cells are composed of a variety of structures such as the nucleus, cell/plasma membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts.

Item Specifications:

Emphasis:

Know the function and structure of the nucleus, cell membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts.

Stimulus Attributes:

Items may include written descriptions, graphical representations, Venn diagrams and data tables.

Format:

Assessable content includes:

1. Compare and contrast prokaryotic and eukaryotic cells using structural characteristics to differentiate between bacteria, plant, fungal and animal cells (i.e., nucleus, cell/plasma membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts).
2. Classify cells as plant, animal, fungal or bacterial, based on assessable structures (i.e., nucleus, cell [plasma] membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts).
3. Identify and classify major cell structures in relation to their function, such as: nucleus, cell/plasma membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts.
4. Identify the general function of the following cell structures: nucleus, cell membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts.
5. Describe the special functions of the cell membrane including osmosis and diffusion.
6. Differentiate between hypotonic, hypertonic, and isotonic conditions between a cell and its environment.
7. Explain each of the following processes by recognizing and interpreting process/chart/or diagrams related to how materials are exchanged across membranes (i.e., active and passive transport, osmosis, and diffusion).
8. Identify and explain how cell structures help various organisms maintain homeostasis.

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Item Content Limits:
Non-assessable content includes:

1. Specific knowledge of these structures: cytoskeleton, lysosome, centrioles, endoplasmic reticulum, golgi apparatus, cytosol, vacuoles, cilia, and flagella.
2. Knowledge related to the specific chemical/ molecular structure and/or chemical interaction with other organelles or structures around it that would be above the level of Biology I.

Process Objectives May Include:
Items may be written to assess any of the process objectives, except for P3.5.

Distractor Domain:

1. Incorrect or irrelevant structures
2. Incorrect or irrelevant functions
3. Incorrect relationships between structure and function
4. Incorrect properties or characteristics of prokaryotic or eukaryotic cells
5. Incorrect classification or grouping of cells or events from given information
6. Predictions, structures or functions not supported by given data/diagrams/or charts
7. Inferences, analyses, or conclusions not supported by given observations or data

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***Oklahoma C³* Standard:**

Content Standard 1: The Cell – Cells are the fundamental unit of life, composed of a variety of structures that perform functions necessary to maintain life. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

***Oklahoma C³* Objective:**

Content Objective 1: Cells are composed of a variety of structures such as the nucleus, cell/plasma membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts.

***Oklahoma C³* Skill:**

Content Skill 1.1a: The cell/plasma membrane functions (i.e., active transport, passive transport, diffusion, osmosis, and surface area to volume ratio) to maintain homeostasis.

Item Specifications:

Emphasis:

Know the function and structure of the nucleus, cell membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts.

Stimulus Attributes:

Items may include written descriptions, graphical representations, Venn diagrams and data tables.

Format:

Assessable content includes:

1. Compare and Compare and contrast prokaryotic and eukaryotic cells using structural characteristics to differentiate between bacteria, plant, fungal and animal cells (i.e., nucleus, cell/plasma membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts).
2. Classify cells as plant, animal, fungal or bacterial, based on assessable structures (i.e., nucleus, cell [plasma] membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts).
3. Identify and classify major cell structures in relation to their function, such as: nucleus, cell/plasma membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts.
4. Identify the general function of the following cell structures: nucleus, cell membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts.
5. Describe the special functions of the cell membrane including osmosis and diffusion.
6. Differentiate between hypotonic, hypertonic, and isotonic conditions between a cell and its environment.
7. Explain each of the following processes by recognizing and interpreting process/chart/or diagrams related to how materials are exchanged across membranes (i.e., active and passive transport, osmosis, and diffusion).
8. Identify and explain how cell structures help various organisms maintain homeostasis.

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***Oklahoma C³* Standard:**

Content Standard 1: The Cell – Cells are the fundamental unit of life, composed of a variety of structures that perform functions necessary to maintain life. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

***Oklahoma C³* Objective:**

Content Objective 1: Cells are composed of a variety of structures such as the nucleus, cell/plasma membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts.

***Oklahoma C³* Skill:**

Content Skill 1.1b: Differentiate among hypotonic, hypertonic, and isotonic conditions.

Item Specifications:

Emphasis:

Know the function and structure of the nucleus, cell membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts.

Stimulus Attributes:

Items may include written descriptions, graphical representations, Venn diagrams and data tables.

Format:

Assessable content includes:

1. Compare and contrast prokaryotic and eukaryotic cells using structural characteristics to differentiate between bacteria, plant, fungal and animal cells (i.e., nucleus, cell/plasma membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts).
2. Classify cells as plant, animal, fungal or bacterial, based on assessable structures (i.e., nucleus, cell [plasma] membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts).
3. Identify and classify major cell structures in relation to their function, such as: nucleus, cell/plasma membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts.
4. Identify the general function of the following cell structures: nucleus, cell membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts.
5. Describe the special functions of the cell membrane including osmosis and diffusion.
6. Differentiate between hypotonic, hypertonic, and isotonic conditions between a cell and its environment.
7. Explain each of the following processes by recognizing and interpreting process/chart/or diagrams related to how materials are exchanged across membranes (i.e., active and passive transport, osmosis, and diffusion).
8. Identify and explain how cell structures help various organisms maintain homeostasis.

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***Oklahoma C³* Standard:**

Content Standard 1: The Cell – Cells are the fundamental unit of life, composed of a variety of structures that perform functions necessary to maintain life. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

***Oklahoma C³* Objective:**

Content Objective 1: Cells are composed of a variety of structures such as the nucleus, cell/plasma membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts.

***Oklahoma C³* Skill:**

Content Skill 1.1c: Compare and contrast prokaryotic and eukaryotic cells.

Item Specifications:

Emphasis:

Know the function and structure of the nucleus, cell membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts.

Stimulus Attributes:

Items may include written descriptions, graphical representations, Venn diagrams and data tables.

Format:

Assessable content includes:

1. Compare and contrast prokaryotic and eukaryotic cells using structural characteristics to differentiate between bacteria, plant, fungal and animal cells (i.e., nucleus, cell/plasma membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts).
2. Classify cells as plant, animal, fungal or bacterial, based on assessable structures (i.e., nucleus, cell [plasma] membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts).
3. Identify and classify major cell structures in relation to their function, such as: nucleus, cell/plasma membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts.
4. Identify the general function of the following cell structures: nucleus, cell membrane, cell wall, cytoplasm, ribosomes, mitochondria, and chloroplasts.
5. Describe the special functions of the cell membrane including osmosis and diffusion.
6. Differentiate between hypotonic, hypertonic, and isotonic conditions between a cell and its environment.
7. Explain each of the following processes by recognizing and interpreting process/chart/or diagrams related to how materials are exchanged across membranes (i.e., active and passive transport, osmosis, and diffusion).
8. Identify and explain how cell structures help various organisms maintain homeostasis.

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Modified *Oklahoma C*[3] Sample Item:
Process Objective: 2.1
Content Objective: 1.1
Depth-of-Knowledge: 2
Correct Response: C

Cell Structures in an Organism

Structure	Present or Absent?
Cell wall	Absent
DNA	Present
Mitochondria	Present
Nucleus	Present

According to the table, how should this organism be classified?

A bacteria

B plant

C animal

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***Oklahoma C³* Standard:**

Content Standard 1: The Cell – Cells are the fundamental unit of life, composed of a variety of structures that perform functions necessary to maintain life. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

***Oklahoma C³* Objective:**

Content Objective 2: In multicellular organisms, cells have levels of organization (i.e., cells, tissues, organs, organ systems, organisms).

Item Specifications:

Emphasis:

Multiple levels of organization exist in organisms. Complexity of structure and function increases at each successive level. All levels work together for the survival of the organism.

Stimulus Attributes:

Items may include descriptions, illustrations (e.g. life cycles), data tables, and graphs

Format:

Assessable content includes:

1. Students will apply knowledge of the general concepts of levels of organization in organisms (i.e., cells, tissues, organs, organ systems, and organisms).
2. Use the concepts of the cell theory to evaluate an experimental design.
3. Correlate appropriate SI units of measure and tools with organizational levels of structure.
4. Compare and contrast the unicellular and multicellular organization (e.g., division of labor, cooperation among cells and colonies, single cell organisms).
5. Describe in general terms how organisms are organized and classified at the cellular, tissue, organ, and organ-system levels.

Item Content Limits:

Non-assessable content includes:

1. The specifics of cell development through the process of cleavage, cell determination and differentiation or stem cell formation.
2. Items will not require knowledge related to the specific chemical/ molecular structure and/or chemical interaction within or between levels of organization that would be above the level of Biology I.
3. Distinguishing between open and closed systems

Process Objectives May Include:

Items may be written to any of the process objectives, except for P3.5.

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Distractor Domain:

1. Wrong level of organization
2. Inappropriate SI units of measure or tools
3. Wrong application of cell theory to experimental design
4. Common misconceptions

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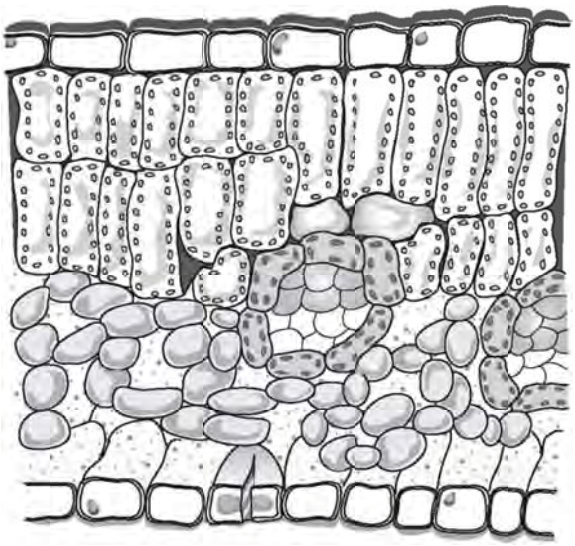
Modified *Oklahoma C³* Sample Item:
Process Objective: 2.1
Content Objective: 1.2
Depth-of-Knowledge: 2
Correct Response: B

The picture shows a cross-section of a plant leaf.



There are many different types of plant cells in the structure.

What is the correct classification for the living structure?

A organism, because different types of cells are involved in gas exchange

B organ system, because a single tissue is involved in support and the movement of water

C organ, because different tissues are involved in gas exchange, support, and photosynthesis

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***Oklahoma C³* Standard:**

Content Standard 1: The Cell – Cells are the fundamental unit of life, composed of a variety of structures that perform functions necessary to maintain life. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

***Oklahoma C³* Objective:**

Content Objective 3: Specialized cells enable organisms to monitor what is going on in the world around them (e.g., detect light, sound, specific chemicals, gravity, plant tropism, sense organs, homeostasis).

Item Specifications:

Emphasis:

Organisms respond physiologically to changes in the environment in order to survive.

Stimulus Attributes:

Items may include descriptions, illustrations, models, data tables, Venn diagrams, and graphs.

Format:

Assessable content includes:

1. Students will apply knowledge of how organisms respond to their environment physiologically.
2. Analyze data and predict immediate physiological response to environmental changes (stimulus and response).
3. Understand the relationship between stimulus and response.
4. Identify a cell's ability to respond to internal changes and external stimuli.
5. Identify and analyze an organism's response to light, sound, chemicals, and gravity.
6. Predict how changes in the immediate environment result in stimulus responses necessary for survival.
7. Interpret models of homeostasis, geotropism, phototropism, feedback loops, and the role of sensory cells.

Item Content Limits:

Non-assessable content includes:

1. Knowledge related to the specific chemical/ molecular structure and/or chemical interaction that would be above the level of Biology I.
2. Complex feedback loops
3. Specialized systems that are beyond the scope of Biology I.

Process Objectives May Include:

Items may be written to assess any of the process objectives, except for P3.5.

Distractor Domain:

1. Data misinterpretations
2. Common misconceptions

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Modified *Oklahoma C³* Sample Item:
Process Objective: 4.4
Content Objective: 1.3
Depth-of-Knowledge: 2
Correct Response: B

Specialized cells in certain male insects produce a scent. Bart hypothesizes that if a male insect does not have scent, then he will not attract females. Bart carries out these steps for the experiment.

1. **extracts the scent molecules from some male insects**
2. **coats a model of the male insect with the scent.**
3. **exposes fifty females to the treated model**
4. **exposes fifty females to a model of the male insect that was not coated with the chemical.**

Which result will provide support for this hypothesis?

A Fewer females are attracted to the treated model than the untreated model.

B More females are attracted to the treated model than the untreated model.

C Females are equally attracted

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***Oklahoma C³* Standard:**

Content Standard 2: The Molecular Basis of Heredity – DNA determines the characteristics of organisms. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

***Oklahoma C³* Objective:**

Content Objective 1: Cells function according to the information contained in the master code of DNA (i.e., cell cycle, DNA replication and transcription). Transfer RNA and protein synthesis will be taught in life science courses with rigor greater than Biology I.

Item Specifications:

Emphasis:

DNA regulates all cellular functions, processes, and heredity.

Stimulus Attributes:

Items may include descriptions, illustrations, models, data tables, Venn diagrams, and graphs.

Format:

Assessable content includes:

1. Students will apply knowledge of DNA and the cell cycle in different contexts, including relating it to various cellular functions, processes, and heredity.
2. Compare and contrast the genetic material (i.e., DNA, RNA) and the nucleotides of each (i.e., adenine, thymine, cystosine, guanine, and uracil).
3. Sequence the events of DNA replication.
4. Interpret basic models of the processes of replication (DNA to DNA) and transcription (DNA to RNA).
5. Interpret a model of DNA in the process of formation of mutations.
6. Identify the parts of the cell cycle (i.e., interphase [G1, S, and G2], mitosis, and cytokinesis).
7. Calculate the number of cells produced over a period of time based upon a set time for the cell cycle. Limited to no more then 3 cycles.
8. Compare/contrast the basic processes and results of meiosis and mitosis (e.g., number of daughter cells produced, number of cell divisions, number of chromosomes, cell type).

Item Content Limits:

Non-assessable content includes:

1. The specific processes and terminology of translation (protein synthesis).
2. Questions which require the student to distinguish between the events of a normal cell cycle and events related to a specific disease.
3. Knowledge regarding specific enzymes related to regulation of the cell cycle.
4. Identify the details of how mutations affect protein formation.
5. Use of specific chemical names and/or chemical processes.
6. The names and events of each stage of mitosis and meiosis and the correct sequence of each.

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Process Objectives May Include:
Items may be written to assess any of the process objectives, except for P3.5.

Distractor Domain:

1. Incorrect response
2. Common misconceptions

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Modified *Oklahoma C³* Sample Item:
Process Objective: 2.2
Content Objective: 2.1
Depth-of-Knowledge: 1
Correct Response: A

Genetic material is classified according to the function it performs. Which term describes a segment of DNA that codes for an inherited trait?

A gene

B genome

C chromosome

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***Oklahoma C³* Standard:**

Content Standard 2: The Molecular Basis of Heredity – DNA determines the characteristics of organisms. The student will engage in investionations that integrate the process standards and lead to the discovery of the following objectives:

***Oklahoma C³* Objective:**

Content Objective 2: A sorting and recombination of genes during sexual reproduction results in a great variety of possible gene combinations from the offspring of any two parents (i.e., Punnett squares and pedigrees). Students will understand concepts in a single trait cross (e.g., alleles, dominant trait, recessive trait, phenotype, genotype, homozygous, heterozygous, incomplete dominance, and sex-linked traits).

Item Specifications:

Emphasis:

A great variety of gene combinations result from sexual reproduction.

Stimulus Attributes:

Items may include descriptions, illustrations, models, data tables, Punnett squares, pedigrees (legends provided), and graphs.

Format:

Assessable content includes:

1. Interpret, analyze, evaluate data, and make predictions from a given monohybrid cross.
2. Use mathematical models to determine the end products of meiosis.
3. Interpret and/or predict possible genetic combinations using Punnett squares and/or pedigrees (e.g., single-trait crosses, sex-linked traits, and incomplete dominance).
4. Identify possible parent (P) genotype given the appropriate offspring (F1 and F2) genotypic ratios.
5. Distinguish the corresponding phenotypes for a given genotype.
6. Predict percentage and/or probability of offspring utilizing a Punnett square.
7. Apply Mendel's principles to solve basic genetics problems involving monohybrid crosses.
8. Identify the appropriate pedigree chart that traces basic patterns of human inheritance.

Item Content Limits:

Non-assessable content includes:

1. The names and events of each stage of meiosis and the correct sequence of each.
2. The specific process of crossing-over or synapses, and tetrads, non-disjunction, multiple alleles and polygenic traits.
3. Categorizing different types of mutations that can occur in DNA.

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4. Knowledge related to the specific chemical/ molecular structure and/or chemical interaction that would be above the level of Biology I.

Process Objectives May Include:
Items may be written to assess any of the process objectives, except for P3.5.

Distractor Domain:
1. Incorrect percentages or ratios
2. Misinterpretation of data
3. Common misconceptions
4. Inappropriate predictions

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Modified *Oklahoma C³* Sample Item:
Process Objective: 3.3
Content Objective: 2.2
Depth-of-Knowledge: 3
Correct Response: B

A certain disease in humans is a recessive trait (n) while the normal condition is dominant (N). The Punnett square below shows the genotypes for a couple that wants to have a child.

	N	n
N		
n		

What is the probability that the couple's child will inherit the disease?

A 0%

B 25%

C 50%

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***Oklahoma C³* Standard:**

Content Standard 3: Biological Diversity – Diversity of species is developed through gradual processes over many generations. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

***Oklahoma C³* Objective:**

Content Objective 1: Different species might look dissimilar, but the unity among organisms becomes apparent from an analysis of internal structures, the similarity of their chemical processes, and the evidence of common ancestry (e.g., homologous and analogous structures, embryology, fossil record, genetic data).

Item Specifications:

Emphasis:

The study of the relatedness among species.

Stimulus Attributes:

Items may include descriptions, illustrations, data tables, models, phylogenetic trees, cladograms, classification keys, and graphs.

Format:

Assessable content includes:

1. Differentiate between appropriate (e.g., fossils, anatomical, embryological development, biochemical, geographical, and ecological evidence) and inappropriate information for determining species relatedness.
2. Compare/contrast divisions of a biological classification system.
3. Identify various relationships among species and how those species have diversified or become more similar over time.
4. Use phylogenetic trees, cladograms, and/or dichotomous keys to discern the relatedness among species.
5. Compare/contrast anatomical features of various organisms.

Item Content Limits:

Non-assessable content includes:

1. The specifics of cell development through the process of cleavage, cell determination, and differentiation or stem cell formation.
2. Classification of viruses
3. Interbreeding between related species, or breeding of individuals under unnatural conditions, such as in captivity will not be addressed. (e.g. coydogs – combination of a dog-coyote hybrids, or grizzly- polar bears)

Process Objectives May Include:

Items may be written to assess any of the process objectives, except for P3.5.

Distractor Domain:

1. Incorrect interpretations
2. Incorrect conclusions
3. Common misconceptions

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Modified *Oklahoma C³* Sample Item:
Process Objective: 2.1
Content Objective: 3.1
Depth-of-Knowledge: 2
Correct Response: B

Characteristics of Four Organisms

Type of Organism	Main Food Source	Number of Toes	Number of Chambers in Stomach	Number of Horns
Goat	Grasses and leaves	2	4	2
Giraffe	Leaves and twigs	2	4	2
Elephant	Many types of vegetation	3 to 5	1	0

According to the information in the table, which two types of organisms are most closely related?

A giraffes and elephants

B giraffes and goats

C horses and elephants

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***Oklahoma C³* Standard:**

Content Standard 3: Biological Diversity – Diversity of species is developed through gradual processes over many generations. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

***Oklahoma C³* Objective:**

Content Objective 2: Characteristics of populations change through the mechanism of natural selection. These biological adaptations, including changes in structures, behaviors, and/or physiology, may enhance or limit survival and reproductive success within a particular environment.

Item Specifications:

Emphasis:

Populations of organisms adapt over time through natural selection. Biological adaptations are genetically determined.

Stimulus Attributes:

Items may include descriptions, illustrations, data tables, models, phylogenetic trees, cladograms, Venn diagrams, and graphs.

Format:

Assessable content includes:

1. Apply knowledge of natural selection in different contexts.
2. Compare/contrast variations within and between populations (including niches and biomass) using the process of natural selection.
3. Distinguish between short-term adjustment to environment and a biological adaptation.
4. Apply the concept that populations of organisms adapt over time.
5. Apply the concept that biological adaptations are determined genetically.
6. Distinguish between evolutionary patterns, phylogenetic trees, and cladograms, being able to read and interpret each type of model.
7. Apply the general idea that mutations occur randomly and are selected because they help some organisms survive and produce more offspring.
8. Identify structures, behaviors, or physiology between or among species, within the context of a biome, that would enhance or limit the survival and reproductive success in a specific environment (e.g., in the desert for water conservation, or in the Arctic tundra for resource acquisition, comparing an organism's adaptations to what is required to live in a biome).

Item Content Limits:

Non-assessable content includes:

1. Knowledge related to the specific chemical/ molecular structure and/or chemical interaction that would be above the level of Biology I.
2. Describing man-made strategies used in conservation biology.

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3. Relating success in protecting an endangered species to the methods used to protect it.
4. Specific details of biomes not related to the interactions between species or structures, behaviors or physiology (e.g., microclimates).

Process Objectives May Include:
Items may be written to assess any of the process objectives, except for P3.5.

Distractor Domain:

1 Organisms deciding, attempting, or trying to adapt
2. Incorrect conclusions or predictions
3. Misconceptions relating to short term and long term adaptations (e.g., failure to make a conceptual connection between the occurrence of new variations in a population and the potential effect of those variations on long-term survival of the species)

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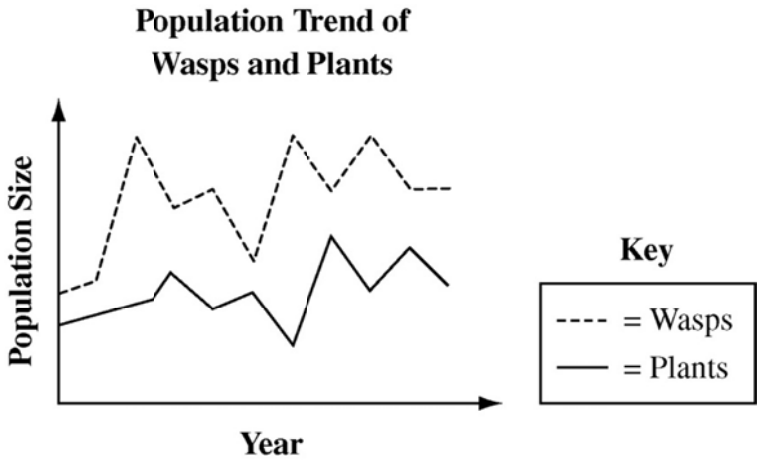
Modified *Oklahoma C³* Sample Item:
Process Objective: 4.1
Content Objective: 3.2
Depth-of-Knowledge: 2
Correct Response: A

A certain species of wasp is the only pollinator for a certain species of plant. The plant is the only source of food and shelter for the wasp. The graph shows the plant and wasp population trends.



Which will most likely happen to the plant population if an introduced disease kills all the wasps in a short period of time?

A It will become extinct.

B It will be pollinated by other species of wasps.

C It will change into a different species of plant.

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***Oklahoma C³* Standard:**

Content Standard 3: Biological Diversity – Diversity of species is developed through gradual processes over many generations. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

***Oklahoma C³* Objective:**

Content Objective 3: Broad patterns of behavior exhibited by animals have changed over time to ensure reproductive success. Responses to external stimuli can result from interactions with the organism's own species and others, as well as environmental changes; these responses can be either innate or learned.

Item Specifications:

Emphasis:

Species display complex behaviors that ensure reproductive success.

Stimulus Attributes:

Items may include descriptions, illustrations, models, data tables, and graphs.

Format:

Assessable content includes:

1. Apply the concepts of innate and learned behaviors to survival and/or reproductive success.
2. Classify simple behavioral adaptations displayed by species as innate or learned to ensure reproductive success.
3. Describe how the following behaviors influence reproductive success (e.g., migration, hibernation, schooling, flocking, territoriality, mating rituals, and feeding behavior).
4. Predict an organism's behavioral responses to long-term environmental changes (e.g., plant tropisms, and migratory patterns).
5. Identify an organism's behavioral responses caused by interactions with the organism's own species and with other species (e.g., social behaviors, communication).

Item Content Limits:

Non-assessable content includes:

1. Knowledge related to the specific chemical/ molecular structure and/or chemical interactions that would be above the level of Biology I.

Process Objectives May Include:

Items may be written to assess any of the process objectives, except for P3.5.

Distractor Domain:

1. Misinterpreting effect of behavior or reproductive success
2. Common misconceptions

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Modified *Oklahoma C³* Sample Item:
Process Objective: 4.5
Content Objective: 3.3
Depth-of-Knowledge: 2
Correct Response: C

A group of students studied the effect of an acidic environment on the survival of a certain organism.

Effect of pH Level on Survival of an Organism

	Number of Surviving Individuals		
Environmental Conditions	**Day 1**	**Day 2**	**Day 3**
pH 4	30	15	13
pH 5	30	25	20
pH 6	30	27	26

According to the table, which pH level is best for the organisms' survival?

A 4

B 5

C 6

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***Oklahoma C³* Standard:**

Content Standard 4: The Interdependence of Organisms – Interdependence of organisms in an environment includes the interrelationships and interactions between and among organisms. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

***Oklahoma C³* Objective:**

Content Objective 1: Organisms both cooperate and compete in ecosystems (e.g., symbiotic relationships).

Item Specifications:

Emphasis:

Identify, analyze, or evaluate interactions within a species and between species.

Stimulus Attributes:

Items may include descriptions, illustrations, models, data tables, Venn diagrams, and graphs.

Format:

Assessable content includes:

1. Students will apply knowledge of the basic types of interactions between organisms.
2. Compare /Contrast the variations within and between populations (population, niche, habitat, community, and ecosystem) and the process of natural selection.
3. Classify relationships between organisms in an ecosystem (i.e., mutualism, parasitism, symbiosis, and or predator-prey).
4. Analyze a biological model of given ecosystem.
5. Relate and identify interactions between species within the context of a biome (e.g., in the desert for water conservation or in Arctic tundra for resource acquisition)

Item Content Limits:

Non-assessable content includes:

1. Items will not require knowledge related to the specific chemical/ molecular structure and/or chemical interaction that would be above the level of Biology I.
2. Specific details of biomes not related to interactions between species (e.g., microclimates)

Process Objectives May Include:

Items may be written to assess any of the process objectives, except for P3.5.

Distractor Domain:

1. Incorrect relationships
2. Common misconceptions

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Modified *Oklahoma C³* Sample Item:
Process Objective: 4.5
Content Objective: 4.1
Depth-of-Knowledge: 3
Correct Response: A

Gulls will steal food directly from other birds, including oystercatchers. A researcher observed oystercatchers hunting for prey with and without gulls present.

Effect of Gulls on Oystercatcher Feeding

Gulls Present?	Prey Captured	Prey Eaten
Yes	9	5
No	8	8

Which conclusion about the gull-oystercatcher relationship is supported by the data?

A Gulls benefit while oystercatchers are harmed.
B Gulls benefit and the oystercatchers are unaffected.
C Gulls and oystercatchers both benefit by cooperation.

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***Oklahoma C³* Standard:**

Content Standard 4: The Interdependence of Organisms – Interdependence of organisms in an environment includes the interrelationships and interactions between and among organisms. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

***Oklahoma C³* Objective:**

Content Objective 2: Living organisms have the capacity to produce populations of infinite size, but environments and resources limit population size (e.g., carrying capacity, limiting factors, ecological succession).

Item Specifications:

Emphasis:

Identify, analyze, and evaluate factors affecting population size. Predict possible changes in populations.

Stimulus Attributes:

Items may include descriptions, illustrations, models, data tables, and graphs (including those making use of a broken axis).

Format:

Assessable content includes:

1. Describe how populations are limited (e.g., predation, food supply, and change in habitat).
2. Identify factors that limit an environment's biotic potential.
3. Identify the impact of the following terms on population size: carrying capacity, natality (birth rate), mortality (death rate), immigration, emigration, and population density.
4. Explain the predator-prey relationship in terms of limiting factors for populations.
5. Predict possible changes in populations.
6. Identify and analyze factors related to ecological succession that would have an effect upon population size, and/or an ecosystem's carrying capacity.

Item Content Limits:

Non-assessable content includes:

1. Compare the age structure of rapidly growing, slow-growing and no-growth countries.

Process Objectives May Include:

Items may be written to assess any of the process objectives, except for P3.5.

Distractor Domain:

1. Incorrect relationships
2. Common misconceptions
3. Misinterpretations of graphics
4. Miscalculations

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Modified *Oklahoma C*^{3} Sample Item:
Process Objective: 4.5
Content Objective: 4.2
Depth-of-Knowledge: 1
Correct Response: B

A scientist is growing cells in a solution containing water, amino acids, sugar, and salts. Just before the cells stop growing, the sugar in the solution runs out. If more sugar is added, the cells will continue to grow.

Which role does the sugar have in this system?

A control

B limiting factor

C dependent variable

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***Oklahoma C³* Standard:**

Content Standard 5: Matter, Energy, and Organization in Living Systems – Living systems require a continuous input of energy to maintain their chemical and physical organizations. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

***Oklahoma C³* Objective:**

Content Objective 1: The complexity and organization of organisms accommodates the need for obtaining, transforming, transporting, releasing, and eliminating the matter and energy used to sustain the organism (i.e., photosynthesis and cellular respiration).

Item Specifications:

Emphasis:

The basic processes of photosynthesis and respiration and the relationship between the two processes. All organisms use cellular respiration to obtain energy from food.

Stimulus Attributes:

Items may include descriptions, illustrations, models, data tables, and graphs.

Format:

Assessable content includes:

1. Students will apply knowledge of photosynthesis and respiration in different contexts.
2. Items will focus on photosynthesis and cellular respiration—the need to make food and release energy from food and the basic steps in these processes.
3. Identify why organisms need energy and how they obtain it.
4. Evaluate the importance of energy to living things.
5. Compare and contrast the basic processes and equations of photosynthesis and cellular respiration. Photosynthesis requires light, carbon dioxide (CO_2), chlorophyll, and water (H_2O), which produces oxygen (O_2) and glucose ($C_6H_{12}O_6$). Respiration requires glucose ($C_6H_{12}O_6$) and oxygen (0_2) which produces carbon dioxide (CO_2), water (H_2O), and releases energy (ATP).
6. Apply knowledge of the role of cellular respiration and photosynthesis in conservation and cycling of matter and energy.
7. Apply the concept that all energy available to living things ultimately relies on the sun.
8. Differentiate between the reactants and products of photosynthesis and cellular respiration.

Item Content Limits:

Non-assessable context includes:

1. ATP - Chemical composition of, formation and breaking down ATP.
2. Formation of ADP.

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3. Specifics of the Krebs cycle.
4. Organic compounds and chemical reactions outside of the basic equations for photosynthesis and cellular respiration.
5. Specifics of the Calvin cycle and how CO_2 is used to make glucose.
6. Comparing and contrasting aerobic and anaerobic respiration.
7. Types of chemical bonds between the atoms of carbon-containing molecules.
8. Balancing of chemical equations.

Process Objectives May Include:

Items may be written to any of the process objectives, except for P3.5.

Distractor Domain:

1. Common misconceptions (e.g., plant cells do not respire, living systems do not require a continuous input of energy to maintain their chemical and physical organizations)
2. Incorrect relationships between cellular respiration and photosynthesis.

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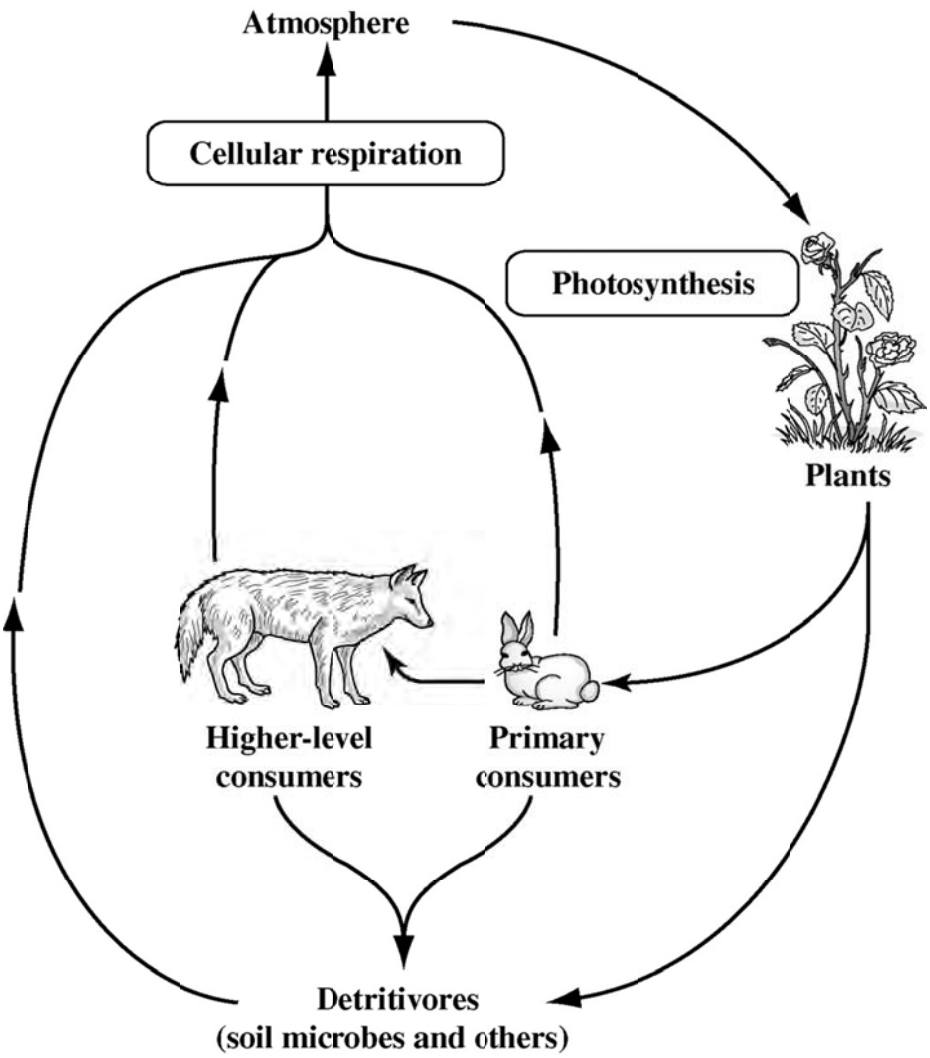
Modified *Oklahoma C³* Sample Item:
Process Objective: 5.1
Content Objective: 5.1
Depth-of-Knowledge: 2
Correct Response: A

The model below shows how carbon is recycled in ecosystems.



Which best explains how plants contribute to this cycle?

A Plants combine carbon dioxide and water to make food.

B Plants obtain their food energy directly from the soil.

C Plants combine carbon dioxide and oxygen to make food.

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***Oklahoma C³* Standard:**

Content Standard 5: Matter, Energy, and Organization in Living Systems – Living systems require a continuous input of energy to maintain their chemical and physical organizations. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

***Oklahoma C³* Objective:**

Content Objective 2: As matter and energy flow through different levels of organization of living systems and between living systems and the physical environment, chemical elements are recombined in different ways by different structures. Matter and energy are conserved in each change (i.e., water cycle, carbon cycle, nitrogen cycle, food webs, and energy pyramids).

Item Specifications:

Emphasis:

Energy and matter are conserved in various levels of organization as they are transferred from one component of the biosphere to another.

Stimulus Attributes:

Items may include descriptions, illustrations, models, data tables, Venn diagrams, and graphs.

Format:

Assessable content includes:

1. Students will apply knowledge of how matter and energy are transferred in different scenarios.
2. Compare/contrast between autotrophs and heterotrophs.
3. Compare/contrast among producer and consumer (i.e., herbivores, carnivores, omnivores, and decomposers).
4. Apply the concepts of matter and energy flow through ecosystems as chemical elements are recombined and matter and energy are conserved (i.e., water cycles, carbon cycles, nitrogen cycle, food webs, food chains, and energy pyramids).
5. Interpret a model illustrating the direction of energy flow through the biogeochemical cycles (i.e., carbon, water, and nitrogen cycles.)
6. Explain the effect of changes of the components of biogeochemical processes (i.e., water, carbon, and nitrogen cycles) on or between living systems and the physical environment.
7. Apply the concepts of Conservation of Matter and Energy to the processes of photosynthesis and cellular respiration.

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Item Content Limits:
Non-assessable content includes:

1. Stating the laws of thermodynamics.
2. Knowledge related to the specific chemical/ molecular structure and/or chemical interaction that would be above the level of Biology I.
3. Balancing of chemical equations.

Process Objectives May Include:
Items may be written to any of the process objectives, except for P3.5.

Distractor Domain:

1. Incorrect interpretations
2. Common misconceptions

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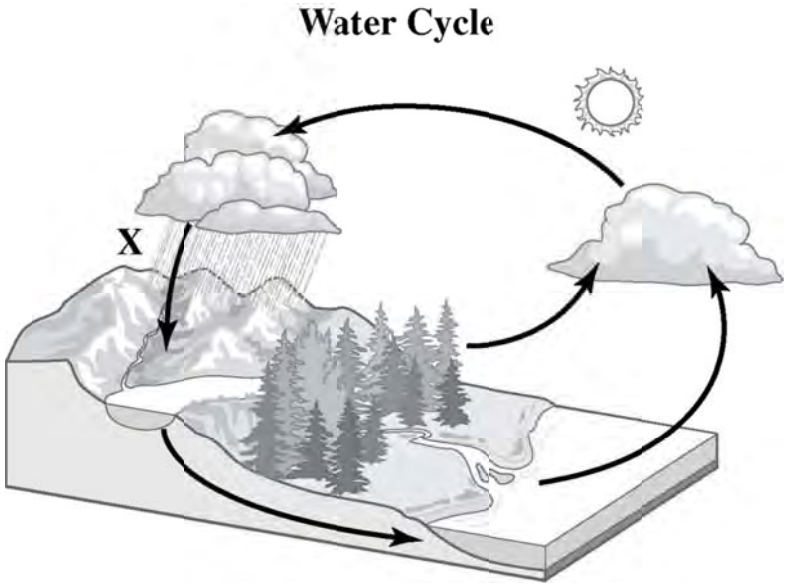
Modified *Oklahoma C³* Sample Item:
Process Objective: 5.1
Content Objective: 5.2
Depth-of-Knowledge: 1
Correct Response: C



Which term identifies the process labeled X?

A evaporation

B condensation

C precipitation

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***Oklahoma C³* Standard:**

Content Standard 5: Matter, Energy, and Organization in Living Systems – Living systems require a continuous input of energy to maintain their chemical and physical organizations. The student will engage in investigations that integrate the process standards and lead to the discovery of the following objectives:

***Oklahoma C³* Objective:**

Content Objective 3: Matter on earth cycles among the living (biotic) and nonliving (abiotic) components of the biosphere.

Item Specifications:

Emphasis:

All matter is conserved and cycles repeatedly between the biotic and abiotic systems within the biosphere.

Stimulus Attributes:

Items may include descriptions, illustrations, models, data tables, Venn diagrams, and graphs.

Format:

Assessable content includes:

1. Describe biogeochemical processes, function of decomposers, and cycling of nutrients.
2. Apply the concept that all matter is conserved and it is cycled repeatedly between the biotic and abiotic systems within a biosphere.
3. Analyze a diagram to identify or classify the living and nonliving components of the biosphere.
4. Understand and identify the processes involved in the movement of matter between living and nonliving components of the biosphere.
5. Identify the processes of photosynthesis and cellular respiration as either a part of the biotic and abiotic cycles.

Content Limits:

Non-assessable content includes:

1. Items will not require knowledge related to the specific chemical/ molecular structure and/or chemical interaction that would be above the level of Biology I.

Process Objectives May Include:

Items may be written to any of the process objectives, except for P3.5.

Distractor Domain:

1. Incorrect relationships between the biotic and abiotic components of the biosphere
2. Energy flow through an ecosystem in the wrong direction
3. Common misconceptions

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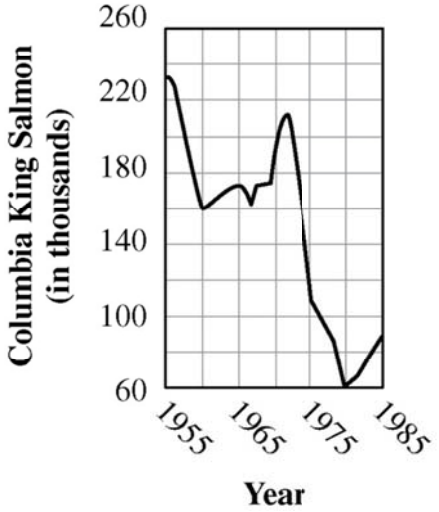
Modified *Oklahoma C³* Sample Item:
Process Objective: 1.1
Content Objective: 4.1
Depth-of-Knowledge: 3
Correct Response: B

A team of biologists studied how changes in climate affected the Columbia River king salmon population over a 30-year period.

Climate Conditions in Columbia River Region, 1956–1985

Time Period	Temperature	Rainfall
1956–1965	Average	Average
1966–1975	Cool	High
1976–1985	Warm	Low

King Salmon Population of Columbia River



What were the climate conditions when the salmon population was lowest?

A cool temperatures and high rainfall

B warm temperatures and low rainfall

C average temperatures and low rainfall

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