Item Specifications for the Indiana Assessment Biology (Beginning 2018-19 School Year)

These item specifications serve as a foundational resource in the assessment development process. This document is the first in a series of documents that will be made available in the future.

Item specifications identify the standards being assessed in addition they provide information about each of the related items including evidence elicited, depth of knowledge (DOK), limits and constraints, and item types. Panels of content teachers at each grade level, representative of Indiana student populations, in partnership with the Department of Education developed the item specifications.

The 2016 Indiana Science Standards increased the breadth and scope of the 2010 standards by adding a new component: process standards. Students are expected to identify and explain content, as well as understand how the data were collected and analyzed to reach those conclusions (scientific and engineering process). The Indiana assessment is designed to test students' understanding of science and engineering processes in conjunction with content. They are expected to integrate both into their understanding and answers.

In addition to the new content and process standards, Indiana added computer science standards to keep up with the changing technological environment our students face. These standards help prepare them to be responsible digital citizens and understand the role technology plays in modern society. Federal accountability requires that these be tested with the science content and process standards.

Overview

The rows of each item specification highlight key features of items included on Indiana assessments as follows:

Reporting Category: The broad content category for the standard representing a segment or domain of content approved by educators as key for reporting. Examples across content areas may include: Number Sense in Mathematics (7.NS); Physical Science in Science (4.PS); and Writing in English/Language Arts (9-10.W).

Standard: Each Indiana Academic Standard is noted under the Reporting Category.

Evidence Statement(s): Statements that describe the knowledge and skills that an assessment item should elicit from students.

Content Limit(s)/ Constraint(s): Statements that list the boundaries or limits of the statements included in the items.

Depth of Knowledge: Webb's Depth of Knowledge categorizes items by the complexity of thinking required. Descriptions of each level are: (1) recall and reproduction, (2) skills and concepts, (3) strategic thinking, and (4) extended thinking. For a complete description of each go to: http://www.doe.in.gov/sites/default/files/assessment/depth-knowledge-powerpointenglish-10.pdf

Item Type(s): Four possible item types including multiple choice (MC), constructed response (CR), technology-enhanced (TE), and extended response (ER).

Sample Item Stem(s): Examples of items stems that satisfy the requirements of the specification.

Sample Item(s): Full example items that satisfy the requirements of the specifications.

Reporting Category	B.1 - Cellular Structure and Function
Standard	B.1.1 - Compare and contrast the shape and function of the essential biological macromolecules (i.e. carbohydrates, lipids, proteins, and nucleic acids), as well as, how chemical elements (i.e. carbon, hydrogen, oxygen, nitrogen, phosphorus, and sulfur) can combine to form these biomolecules.
Evidence Statement(s)	Students sort descriptive statements about function and shape into the four macromolecule categories, including statements that apply to more than one category of biomolecule. Students classify images of the biomolecules. Students explain the relationship between polymers and monomers (ex: proteins are made of amino acids). Students identify major macromolecules, describe their function, and contrast structural formulas (function part is the major component of this standard). Students discuss the different and important uses of each biomolecule in an organism or cell (for example, carbs are the energy source used by the mitochondria, lipids make up the cell membrane and provide protection and structure and proteins include enzymes and structural components of most of the "body" of an organism, and DNA contains the code for making all life.
Content Limit(s)/ Constraint(s)	Cover carbohydrates, lipids, proteins, and nucleic acids only. Exclude: Functional groups, breakdown of monomers (except parts of a nucleotide), types of bonding in macromolecules, saturated vs. unsaturated fats, compounds and mixtures. Do not assess minerals and other compounds needed by organisms. Cannot assume that students have had any chemistry—extensive explanation of chemical formulas/models of large biomolecules is a limitation at this point.
Depth of Knowledge	2
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	What elements are present in…? Compare/contrast the function of {macromolecules}.

Reporting Category	B.1 - Cellular Structure and Function
Standard	B.1.2 - Analyze how the shape of a molecule determines its role in the many different types of cellular processes (e.g., metabolism, homeostasis, growth and development, and heredity) and understand that the majority of these processes involve proteins that act as enzymes.
Evidence Statement(s)	Given the shape of a molecule, students determine which functions may or may not be performed by the molecule. Students explain that enzymes are substrate-specific and increase the rate at which a reaction occurs. Students describe that conditions like high temperature and low pH alter the shape of an enzyme's active site, decreasing the rate of reaction. Students describe how a cell obtains, manufactures, and uses food, protein, and water. Students explain how the shape of a biomolecule helps it fulfill is role in the cell. (Example: In a cell membrane, the lipid bilayer is made of lipids and is organized in a way that it will regulate what goes in and out of the cell).
Content Limit(s)/ Constraint(s)	Assess only the four major biomolecule groups (carbohydrates, lipids, proteins, and nucleic acids). Do not assess vitamins, co-enzymes, cellular processes that play a role in feedback mechanisms.
Depth of Knowledge	3
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Describe the function of {molecule} in the cell. Explain how the shape of {molecule} helps it perform {function}. Explain the role of enzymes/substrates.

Reporting Category	B.1 - Cellular Structure and Function
Standard	B.1.3 - Develop and use models that illustrate how a cell membrane regulates the uptake of materials essential for growth and survival while removing or preventing harmful waste materials from accumulating through the processes of active and passive transport.
Evidence Statement(s)	Students describe the structure and function of the cell membrane. Students explain that molecules move passively down concentration gradients and require energy to move against concentration gradients. Students construct analogies that describe how materials move in and out of cells across cell membranes (may be better for classroom assessments). Students predict how molecules/ions will move based on concentration gradient. Students compare active and passive transport, identify necessary components of cell transport, and draw an illustration of cell transport.
Content Limit(s)/ Constraint(s)	None
Depth of Knowledge	3
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Compare/contrast active and passive transport. What is necessary for active transport? Describe/design/label/complete a diagram that shows active/passive transport through a cell membrane.

Reporting Category	B.1 - Cellular Structure and Function
Standard	B.1.4 - Develop and use models to illustrate how specialized structures within cells (i.e. nuclei, ribosomes, Golgi, endoplasmic reticulum) interact to produce, modify, and transport proteins.
Evidence Statement(s)	Students trace protein production from the nucleus through the Golgi, including the order and location of each event. Students explain that proteins are produced on ribosomes and modified in the Golgi apparatus and transported to the membrane for export by vesicles. Students make a model of a cell focusing on protein synthesis. Students explain what would happen if an organelle is removed from the process of protein synthesis.
Content Limit(s)/ Constraint(s)	Assess only the cell parts listed in the standard (the focus is on the parts involved in protein synthesis). Limit the scope of the Golgi and endoplasmic reticulum to their role in making, modifying, and transporting protein. This implies the focus of the endoplasmic reticulum is on the rough endoplasmic reticulum and not the smooth endoplasmic reticulum. Images of organelles should be labeled.
Depth of Knowledge	3
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Which organelle(s) are responsible for {aspect of protein development/transport}? Fill in the missing component of this diagram to complete protein production. How should this diagram be modified to…?

Reporting Category	B.1 - Cellular Structure and Function
Standard	B.1.5 - Develop and use a model to illustrate the hierarchical organization of interacting systems (cell, tissue, organ, organ system) that provide specific functions within multicellular organisms.
Evidence Statement(s)	Students put levels of organization in order. Students explain that cells are organized into tissues, tissues organized into organs, organs into organ systems. Students explain that different types of cells make up tissues, organs, etc., that have different functions. Students explain that organ systems perform functions that are necessary for life including circulatory, respiratory, digestive, excretory, nervous, and musculo-skeletal systems.
Content Limit(s)/ Constraint(s)	Do not assess specific tissue types or organs. Do not assess the interactions at the molecular level that give rise to different tissue types. Use animals as the context, but not plants, in the assessment.
Depth of Knowledge	2
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	What level of organization comes next in this diagram?

Reporting Category	B.2 - Matter Cycles and Energy Transfer
Standard	B.2.1 - Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
Evidence Statement(s)	Students explain photosynthesis in terms of reactants and products and know that it takes place in chloroplasts. Students select the best descriptive model of photosynthesis. Students describe the source of photosynthesis reactants and where the products go/what they are used for. Students explain that light energy is necessary to create ATP, that plants and algae grown without light cannot perform photosynthesis, and that seeds do not perform photosynthesis. Students identify reactants and products in the chemical equation for photosynthesis. Students show the connection between the products and reactants of photosynthesis.
Content Limit(s)/ Constraint(s)	Do not assess light/dark reactions, the electron transport chain, or other specific steps of photosynthesis. Do not assess specific parts of a chloroplast.
Depth of Knowledge	2
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Which organelle(s) are used in photosynthesis? Complete this diagram to show the process of photosynthesis.

Reporting Category	B.2 - Matter Cycles and Energy Transfer
Standard	B.2.2 - Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
Evidence Statement(s)	Students explain cellular respiration in terms of reactants/inputs and products/outputs and know that much of it takes place in the mitochondria. Students select the best descriptive model of cellular respiration. Students explain that cellular respiration creates ATP, which is a form of energy that cells can use to do work. Students show the connection between the products and reactants of cellular respiration.
Content Limit(s)/ Constraint(s)	Do not assess the specific stages of respiration (e.g., glycolysis, Krebs cycle, electron transport chain). Do not assess specific locations within the mitochondria. Do not assess the term "chemiosmosis."
Depth of Knowledge	2
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	What are the reactants/products of cellular respiration? Which diagram best describes cellular respiration? Complete this diagram of cellular respiration. Explain the importance of cellular respiration to…

Reporting Category	B.2 - Matter Cycles and Energy Transfer
Standard	B.2.3 - Use mathematical and/or computational representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
Evidence Statement(s)	Students understand that carbon dioxide used by photosynthetic organisms was released during cellular respiration. Photosynthetic organisms release oxygen which organisms use during cellular respiration. Students describe the reduction of energy from one energy source to another. Compare energy amounts in various organisms/trophic levels in an energy pyramid or food web/chain. Given the amount of energy in one trophic level, students use the 10% rule to estimate the amount of energy in other trophic levels. Students analyze an energy, mass, or numbers pyramid to explain how much/many energy/mass/individuals will be at the secondary or tertiary level.
Content Limit(s)/ Constraint(s)	Do not assess potassium, phosphorus, sulfur, or various other cycles. Do not include biochemical reactions other than photosynthesis, cellular respiration, and nitrogen fixation.
Depth of Knowledge	3
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	If producers in {this system} produce {amount of energy}, how much energy would be available at {specific trophic level}? Describe the flow of carbon dioxide/oxygen/energy among organisms in {ecosystem}.

Reporting Category	B.2 - Matter Cycles and Energy Transfer
Standard	B.2.4 - Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
Evidence Statement(s)	Students describe the sequence of steps in the carbon cycle and how carbon moves between the biosphere, atmosphere, hydrosphere, and geosphere. Given both chemical equations for the processes, students explain where each reactant/product comes from.
Content Limit(s)/ Constraint(s)	None
Depth of Knowledge	3
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Complete this diagram to show the cycling of carbon in… Explain how carbon cycles in…

Reporting Category	B.3 - Interdependence
Standard	B.3.1 - Use mathematical and/or computational representation to explain why the carrying capacity ecosystems can support is limited by the available energy, water, oxygen, and minerals and by the ability of ecosystems to recycle the remains of dead organisms.
Evidence Statement(s)	Given data, students generate a graph showing population growth, and explain what is happening during the different time periods shown in the graph. (Examples: population growing, eventually leveling off as carrying capacity is reached.) Given data, students explain population growth in an ecosystem in terms of limiting factors. Students analyze a data table that contains info about two different ecosystems, comparing and contrasting the available resources to determine whether either, neither, or both of the ecosystems has reached carrying capacity.
Content Limit(s)/ Constraint(s)	Do not assess types of growth curves (e.g., S vs. J). Focus on the causes for different growth patterns instead.
Depth of Knowledge	3
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Using this graph, explain whether carrying capacity has been reached. Compare/contrast the population data from these two ecosystems. Explain why the population of {species} did not continue to grow/decline in {ecosystem/graph/data table}.

Reporting Category	B.3 - Interdependence
Standard	B.3.2 - Design, evaluate, and refine a model which shows how human activities and natural phenomena can change the flow of matter and energy in an ecosystem and how those changes impact the environment and biodiversity of populations in ecosystems of different scales, as well as, how these human impacts can be reduced.
Evidence Statement(s)	Students pose/describe a solution to an environmental problem to show how impacts can be reduced (such as habitat restoration, reduction in non-renewable consumption, etc.). Students explain that communities with greater diversity are more resistant to factors that create change. Students understand that humans can affect biodiversity in many different ways. Given a scenario, students explain how human impact has altered an ecosystem. Given a scenario, students propose remedies for negative human impacts and identify ways to preserve natural resources. Students evaluate data presented to determine what effect it might have on an environment. Students hypothesize outcomes of human activities and/or natural phenomena.
Content Limit(s)/ Constraint(s)	Do not assess specific types of ecological successions. Provide enough context to answer the item and as much as possible focus on Indiana-based scenarios.
Depth of Knowledge	3
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Describe how human impact has affected... What might be the impact of {human activity} on…? Propose some solutions to reduce the impact of humans on… Explain why the population of {species} did not continue to grow/decline in {ecosystem/graph/data table}.

Reporting Category	B.3 - Interdependence
Standard	B.3.3 - Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, and identify the impact of changing conditions or introducing non-native species into that ecosystem.
Evidence Statement(s)	Given two or more claims that explain the impact of a change to an ecosystem (including the introduction of non-native species), students identify the claim that is best supported, citing specific evidence. Students select the most likely impact that would result from a specific change to environmental conditions or introduction of a non-native species in an ecosystem. Students understand that non-native species may be less successful in diverse communities and that non-native species may become invasive in environments in which limiting factors such as predators have been removed. Students evaluate data to determine what effect an environmental change or non-native species might have on an environment.
Content Limit(s)/ Constraint(s)	Whenever possible use scenarios relevant to Indiana. Do not require students to distinguish types of succession or to know the causes of mass extinctions on the assessment.
Depth of Knowledge	3
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	What is the most likely change that will happen if {non-native species} is introduced to {ecosystem}? Explain why/when non-native species might/might not be successful.

Reporting Category	B.4 - Inheritance and Variation in Traits
Standard	B.4.1 - Develop and revise a model that clarifies the relationship between DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
Evidence Statement(s)	Given multiple models of DNA and/or chromosomes, students select the best representation of each. Students explain the relationship between DNA and chromosomes. Students describe how DNA/chromosomes provide information for traits (they provide the code/ instructions to produce traits in an organism). Students explain that genes are sections of DNA that code for a particular protein. Identify the parts of a chromosome (DNA and proteins).
Content Limit(s)/ Constraint(s)	Do not assess the distinction between chromatids and chromosomes, centromeres, telomeres, and histones.
Depth of Knowledge	2
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Label this diagram of a chromosome. What is the relationship between chromosomes, DNA, and proteins? What is the role of…?

Sample item (MC):

Inherited traits, like the shape of your nose, are primarily determined by:

A) Chromosomes in the nucleus

B) Enzymes in the cytoplasm

C) Proteins expressed by your genes

D) Phosphates between ribosomes

Key: C

Reporting Category	B.4 - Inheritance and Variation in Traits
Standard	B.4.2 - Construct an explanation for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
Evidence Statement(s)	Students explain how the structure of DNA determines the structure of proteins and why proteins are essential to life. Students explain that DNA consists of small sections called genes which code for proteins. Large segments of DNA do not code for proteins but contain switches that regulate gene expression. All genes in a particular cell are not expressed. Students describe the flow of information in the cell from DNA to RNA to proteins.
Content Limit(s)/ Constraint(s)	Do not assess the subcomponents of a nucleotide.
Depth of Knowledge	2
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Describe how information for specific proteins is delivered from the DNA. Explain the function/role of proteins.

Reporting Category	B.4 - Inheritance and Variation in Traits
Standard	B.4.3 - Construct a model to explain that the unique shape and function of each protein is determined by the sequence of its amino acids, and thus is determined by the sequence of the DNA that codes for this protein.
Evidence Statement(s)	Students explain that DNA codes for a specific protein and the order of amino acids determines the shape/function of that protein. If a mutation changes the DNA code, it can affect how a protein is able to function. Provided with a strand of DNA, students determine the mRNA that would be transcribed, then translate the mRNA into a sequence of amino acids using a codon chart.
Content Limit(s)/ Constraint(s)	None
Depth of Knowledge	3
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Translate this mRNA strand into the correct amino acid chain. What will be the effect on the protein given {specific mRNA mutation}? Label/complete this diagram of transcription/translation.

Reporting Category	B.4 - Inheritance and Variation in Traits
Standard	B.4.4 - Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
Evidence Statement(s)	Given a concept map, students select mitosis as the connector between zygote and complex, multicellular organism. Students explain that mitosis is part of the cell cycle that creates identical daughter cells and that multicellular organisms use mitosis for growth and to repair and replace damaged cells.
Content Limit(s)/ Constraint(s)	Do not assess the specific phases of mitosis.
Depth of Knowledge	2
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Mitosis is essential for… Mitosis results in…

Reporting Category	B.4 - Inheritance and Variation in Traits
Standard	B.4.5 - Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and (3) mutations caused by environmental factors.
Evidence Statement(s)	Given situations where one of the three methods of variation is eliminated, students defend a claim that variation could still occur regardless of the one eliminated method. Students explain that meiosis results in genetically different cells that contain half the chromosome number of the parent cell. Students describe how variation is introduced in sexual reproduction due to meiosis (independent assortment and crossing over) and how random fertilization also creates variation. Students know that meiosis occurs so gametes will contain half the number of chromosomes so fertilization can take place. Given a particular simple mutation, students predict the possible outcomes. Given a particular simple mutation, students describe different scenarios of what could have caused it.
Content Limit(s)/ Constraint(s)	Do not assess the phases/stages and specific reactions of meiosis. Do not use the term "haploid." Do not assess specific types of mutations: insertions, deletions, missense, nonsense, non-disjunction, etc.
Depth of Knowledge	3
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Meiosis results in…? Explain how meiosis results in variation within a species.

Reporting Category	B.4 - Inheritance and Variation in Traits
Standard	B.4.6 - Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
Evidence Statement(s)	Students can calculate phenotypic and genotypic ratios using a Punnett square. Students can predict genotypes and phenotypes of parents based on offspring. Students compare and contrast different inheritance patterns.
Content Limit(s)/ Constraint(s)	Punnett squares should be limited to one trait.
Depth of Knowledge	3
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Does this pattern of inheritance show Mendellian/non-Medellian inheritance? Explain. Calculate the percentage of {phenotype/genotype}.

Reporting Category	B.5 - Evolution
Standard	B.5.1 - Evaluate anatomical and molecular evidence to provide an explanation of how organisms are classified and named based on their evolutionary relationships into taxonomic categories.
Evidence Statement(s)	Given information such as DNA/protein sequence or anatomical features of an organism, students place the organism in a taxonomic category. Students use phylogenetic trees to explain common ancestry. Given a cladogram or phylogenetic tree, students interpret/explain the relationships among the different organisms. Given molecular and anatomical evidence, students identify closely related species.
Content Limit(s)/ Constraint(s)	Do not assess: Kingdom, phylum, class, order, family, genus, species.
Depth of Knowledge	3
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	According to this diagram, which organisms are closest/furthest apart genetically?

Reporting Category	B.5 - Evolution
Standard	B.5.2 - Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence including both anatomical and molecular evidence.
Evidence Statement(s)	Students use at least two different lines of evidence to explain evolution. Students describe the concepts that homologous traits indicate common ancestry and analogous traits do not. Vestigial traits indicate that a recent ancestor used that structure for a particular purpose that is no longer needed. Explain how molecular and anatomical evidence support the theory of evolution and common ancestry.
Content Limit(s)/ Constraint(s)	DO NOT include specific different types of evolution (divergent, convergent, etc.) or the terms "analogous" or "vestigial structures."
Depth of Knowledge	3
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Using this diagram/table of {analogous/homologous traits}, identify whether {two or more organisms} are related. Use anatomical and molecular data to support/reject a hypothesis that two organisms are related.

Reporting Category	B.5 - Evolution
Standard	B.5.3 - Apply concepts of statistics and probability to support a claim that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
Evidence Statement(s)	Given survival and reproduction data based on traits in a population, students answer questions applying percentages, rates. Given reproductive rates, students identify which organisms have an advantageous trait. Students explain that since traits are reflective of genes, the genotypes of advantageous traits increase in frequency. Students predict what the future would bring to a species given a set of artificial environmental conditions. Students calculate proportions of the number of organisms after different amounts of time. Students analyze data from generations of bacterial colonies and use statistical evidence to support evidence of natural selection.
Content Limit(s)/ Constraint(s)	Do not assess the term Hardy-Weinberg or the actual formula. Do not assess the term directional selection.
Depth of Knowledge	3
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Predict what would happen to {ecosystem/species/group of species} if… Given {data/graph}, which organisms are best adapted to their environment. Explain

Reporting Category	B.5 - Evolution
Standard	B.5.4 - Evaluate evidence to explain the role of natural selection as an evolutionary mechanism that leads to the adaptation of species, and to support claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and/or (3) the extinction of other species.
Evidence Statement(s)	Given graphs that show increases/decreases in the number of species over time and data about the environment, students explain, with evidence, how natural selection played a role in the trends of the graph. Or they could select the best explanations for the patterns of different lines in the graph. Students explain that changes in the environment can make a trait more or less advantageous and natural selection will increase/decrease its frequency in the population. Students explain that natural selection acts on individuals whereas evolution acts on populations. Students describe how various factors lead to the emergence or extinction of a species.
Content Limit(s)/ Constraint(s)	None
Depth of Knowledge	3
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Explain how natural/man-made changes in the environment might affect a species well-adapted to that environment.

Reporting Category	B.5 - Evolution
Standard	B.5.5 - Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
Evidence Statement(s)	Given a scenario, students explain how the four factors play a role in the process of evolution/natural selection. Students compare characteristics of multiple species and predict which has a better chance of survival.
Content Limit(s)/ Constraint(s)	None
Depth of Knowledge	2
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Which {species} are best/least suited for {environment/ecosystem}?

Reporting Category	B.5 - Evolution
Standard	B.5.6 - Analyze and interpret data for patterns in the fossil record and molecular data that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.
Evidence Statement(s)	Students explain why/how a given pattern in the fossil record shows how organisms evolved/became extinct over time. Students understand the concepts of uniformitarianism, gradualism, and punctuated equilibrium, but are not expected to know the terms. Students recognize that molecular evidence fully supports what the fossil record and anatomical similarities show and that DNA and amino acid sequences are even more concrete.
Content Limit(s)/ Constraint(s)	Do not assess geological eras/epochs or carbon dating methods.
Depth of Knowledge	3
Item Type(s)	Multiple Choice (MC), Technology-Enhanced (TE), Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Using this fossil and molecular data, explain…

Reporting Category	SEPS - Science & Engineering Process Standards ER and CR Items are dual-aligned with content standards.
Standard	SEPS.1 - Posing questions (for science) and defining problems (for engineering) A practice of science is posing and refining questions that lead to descriptions and explanations of how the natural and designed world(s) work and these questions can be scientifically tested. Engineering questions clarify problems to determine criteria for possible solutions and identify constraints to solve problems about the designed world.
Evidence Statement(s)	Students evaluate questions to see if they are testable and relevant. Students generate questions that can be answered by scientific investigations. Students generate questions that clarify problems and identify criteria and constraints for design solutions.
Content Limit(s)/ Constraint(s)	None
Depth of Knowledge	2
Item Type(s)	Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	What is the question the scientist is testing? What question would you ask to meet the criteria/constraints? What variables would need to be controlled to answer the question?

Reporting Category	SEPS - Science & Engineering Process Standards ER and CR Items are dual-aligned with content standards.
Standard	SEPS.2 - Developing and using models and tools A practice of both science and engineering is to use and construct conceptual models that illustrate ideas and explanations. Models are used to develop questions, predictions and explanations; analyze and identify flaws in systems; build and revise scientific explanations and proposed engineered systems; and communicate ideas. Measurements and observations are used to revise and improve models and designs. Models include, but are not limited to: diagrams, drawings, physical replicas, mathematical representations, analogies, and other technological models. Another practice of both science and engineering is to identify and correctly use tools to construct, obtain, and evaluate questions and problems. Utilize appropriate tools while identifying their limitations. Tools include, but are not limited to: pencil and paper, models, ruler, a protractor, a calculator, laboratory equipment, safety gear, a spreadsheet, experiment data collection software, and other technological tools.
Evidence Statement(s)	Students analyze a model to construct questions. Students develop a model to test their questions. Students select the most appropriate model in a given situation and explain their selection. Students select the most appropriate tool in a given situation and explain their selection. Students identify situations in which it is appropriate to use a model. Students create a graph/model/diagram to represent data. Students use appropriate tools to accomplish tasks during an investigation.
Content Limit(s)/ Constraint(s)	Context/models/graphs/tools should be grade-level appropriate.
Depth of Knowledge	3
Item Type(s)	Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Graph the data in the table. Which graph best matches the data in the table? Which tool(s) would the scientist need to use to collect the necessary data? Use/read {tool} accurately.

Reporting Category	SEPS - Science & Engineering Process Standards ER and CR Items are dual-aligned with content standards.
Standard	SEPS.3 - Constructing and performing investigations Scientists and engineers are constructing and performing investigations in the field or laboratory, working collaboratively as well as individually. Researching analogous problems in order to gain insight into possible solutions allows them to make conjectures about the form and meaning of the solution. A plan to a solution pathway is developed prior to constructing and performing investigations. Constructing investigations systematically encompasses identified variables and parameters generating quality data. While performing, scientists and engineers monitor and record progress. After performing, they evaluate to make changes to modify and repeat the investigation if necessary.
Evidence Statement(s)	Students demonstrate knowledge of researching problems in order to identify solutions and how to reach those solutions by using a systematic approach. Students can identify all needed controls and independent/dependent variables in an investigation. Student can plan the process for an investigation. Students evaluate a given set of procedures for possible improvement. Students plan and perform a scientific investigation.
Content Limit(s)/ Constraint(s)	Analogous problems need to be grade-level appropriate.
Depth of Knowledge	3
Item Type(s)	Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	What is the independent/dependent variable in {experiment}? Put the steps in the proper order. Why did the scientist include {specific step} in the experiment?

Reporting Category	SEPS - Science & Engineering Process Standards ER and CR Items are dual-aligned with content standards.
Standard	SEPS.4 - Analyzing and interpreting data Investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists and engineers use a range of tools to identify the significant features in the data. They identify sources of error in the investigations and calculate the degree of certainty in the results. Advances in science and engineering makes analysis of proposed solutions more efficient and effective. They analyze their results by continually asking themselves questions; possible questions may be, but are not limited to: “Does this make sense?” "Could my results be duplicated?" and/or “Does the design solve the problem with the given constraints?”
Evidence Statement(s)	Students demonstrate how data are analyzed in order to identify problems and solutions. Students find a piece of data that is an outlier from the pattern. Students can make predictions/conclusions about what may have gone wrong to result in outliers. Students evaluate data to examine whether a model adequately represents a scenario. Students compare data from graphs, tables, and charts. Students create a graph, table, or chart to organize information.
Content Limit(s)/ Constraint(s)	Make sure the data are presented in a grade-level appropriate format.
Depth of Knowledge	3
Item Type(s)	Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Which {data point} does not match the others? Explain why it might not match. Which statement best describes how the graph is trending?

Reporting Category	SEPS - Science & Engineering Process Standards ER and CR Items are dual-aligned with content standards.
Standard	SEPS.5 - Using mathematics and computational thinking In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; solving equations exactly or approximately; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Scientists and engineers understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
Evidence Statement(s)	Students explain that mathematics and computations support science and these can be used to predict, confirm, and/or express information. Students predict the next data point in a pattern or trend. Students can perform grade-appropriate calculations. Evaluate data and present in concise organized form. Students perform mathematical calculations associated with biological systems and processes.
Content Limit(s)/ Constraint(s)	Math concepts assessed should be one grade level below students' current grade and numbers should be whole numbers.
Depth of Knowledge	3
Item Type(s)	Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Predict the next data point on this graph. What is the average of this set of data?

Reporting Category	SEPS - Science & Engineering Process Standards ER and CR Items are dual-aligned with content standards.
Standard	SEPS.6 - Constructing explanations (for science) and designing solutions (for engineering) Scientists and engineers use their results from the investigation in constructing descriptions and explanations, citing the interpretation of data, connecting the investigation to how the natural and designed world(s) work. They construct or design logical coherent explanations or solutions of phenomena that incorporate their understanding of science and/or engineering or a model that represents it, and are consistent with the available evidence.
Evidence Statement(s)	Students demonstrate how results can be used as evidence. Students give the scientific explanation for why something works. (Use the evidence as a springboard to explain why something works that way/or doesn't work.) Students use background knowledge to explain the science behind a given scientific scenario. Students apply the claim-evidence-reasoning process. Students construct explanations that focus on how or why a phenomenon occurs.
Content Limit(s)/ Constraint(s)	None
Depth of Knowledge	3
Item Type(s)	Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Do the data support/reject the hypothesis? Which of the following conclusions are best supported by this graph/data table?

Reporting Category	SEPS - Science & Engineering Process Standards ER and CR Items are dual-aligned with content standards.
Standard	SEPS.7 - Engaging in argument from evidence Scientists and engineers use reasoning and argument based on evidence to identify the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation, the process by which evidence-based conclusions and solutions are reached, to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims.
Evidence Statement(s)	Students support an argument with evidence or explain why an argument is not supported. Given opposing conclusions or ideas, students select which one the evidence supports. Students compare and contrast opposing conclusions/explanations/solutions. Students apply the claim-evidence-reasoning process to support claims with evidence and reasoning. Students evaluate whether the arguments of others make sense and ask probing questions to clarify or improve the argument. Students review data and construct valid arguments from multiple viewpoints.
Content Limit(s)/ Constraint(s)	None
Depth of Knowledge	3
Item Type(s)	Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Which conclusion is best supported by the evidence? Explain why this argument is not supported by the evidence.

Reporting Category	SEPS - Science & Engineering Process Standards ER and CR Items are dual-aligned with content standards.
Standard	SEPS.8 - Obtaining, evaluating, and communicating information Scientists and engineers need to be communicating clearly and articulating the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations, as well as, orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs.
Evidence Statement(s)	Students demonstrate how scientists and engineers use a variety of ways to communicate ideas and critique work. Students communicate using a variety of methods/tools/formats. Students compare and combine information from multiple texts, considering the strengths of the information and sources. Students communicate findings from a scientific investigation. Students critique investigations communicated by others and evaluate one another's work.
Content Limit(s)/ Constraint(s)	None
Depth of Knowledge	3
Item Type(s)	Extended Response (ER), Constructed Response (CR)
Sample Item Stem(s)	Create a graph from the data table. Which graph would be the best to share the results of the experiment with other scientists/students? Which graph would be the best to share the results of the experiment with other scientists/students?