DRAFT
Grade 6–8/Life Science
Item Specifications

Missouri
DEPARTMENT OF ELEMENTARY & SECONDARY
EDUCATION ™

Table of Contents

Introduction

In 2014 Missouri legislators passed House Bill 1490, mandating the development of the Missouri Learning Expectations. In April of 2016, these Missouri Learning Expectations were adopted by the State Board of Education. Groups of Missouri educators from across the state collaborated to create the documents necessary to support the implementation of these expectations.

One of the documents developed is the item specification document, which includes all Missouri grade level/course expectations arranged by domains/strands. It defines what could be measured on a variety of assessments. The document serves as the foundation of the assessment development process.

Although teachers may use this document to provide clarity to the expectations, these specifications are intended for summative, benchmark, and large-scale assessment purposes.

Components of the item specifications include:

Expectation Unwrapped breaks down a list of clearly delineated content and skills the students are expected to know and be able to do upon mastery of the Expectation.

Depth of Knowledge (DOK) Ceiling indicates the highest level of cognitive complexity that would typically be assessed on a large scale assessment. The DOK ceiling is not intended to limit the complexity one might reach in classroom instruction.

Item Format indicates the types of test questions used in large scale assessment. For each expectation, the item format specifies the type best suited for that particular expectation.

Content Limits/Assessment Boundaries are parameters that item writers should consider when developing a large scale assessment. For example, some expectations should not be assessed on a large scale assessment but are better suited for local assessment.

Sample stems are examples that address the specific elements of each expectation and address varying DOK levels. The sample stems provided in this document are in no way intended to limit the depth and breadth of possible item stems. The expectation should be assessed in a variety of ways.

Possible Evidence indicates observable methods in which a student can show understanding of the expectations.

Stimulus Materials defines types of stimulus materials that can be used in the item stems.

Grades 6-8 SCIENCE

Life Sciences	6-8.LS1.A.1

Core Idea Component MLS	**From Molecules to Organisms: Structure and Processes** **Structure and Function** Provide evidence that organisms (unicellular and multicellular) are made of cells and that a single cell must carry out all of the basic functions of life.	

Expectation Unwrapped	**DOK Ceiling** 3
[Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells.] **SCIENCE AND ENGINEERING PRACTICES** **Planning and Carrying out Investigations** • Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. **DISCIPLINARY CORE IDEAS** **Structure and Function** • All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). **CROSSCUTTING CONCEPTS** **Scale, Proportion, and Quantity** • Phenomena that can be observed at one scale may not be observable at another scale. **Interdependce of Science, Engineering, and Technology** • Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems.	**Item Format** Selected Response Constructed Response Technology Enhanced

Content Limits/Assessment Boundaries
 	
• Tasks should not include the follwoing:
   o Organelle function
   o Chemical interactions (e.g., Krebs Cycle)
   o Microscopy skills
   o Specific knowledge of vocabulary (e.g., "having kids" means "reproduction")
	Sample Stems

Grades 6-8 SCIENCE

Possible Evidence
 	
• Students will
    o describe the presence or absence of cells in living and nonliving things.
    o compare and contrast a living and nonliving things at a microscopic level.
    o describe part of a living thing that is not made up of cells.
    o use of models to differentiate between a cell and atom.
    o describe the functions of living things (e.g., reproduction, growth, response).	

Stimulus Materials Graphic organizers, diagrams, graphs, data tables, drawings	

Grades 6-8 SCIENCE

Life Sciences	6-8.LS1.A.2

Core Idea Component MLS	From Molecules to Organisms: Structure and Processes **Structure and Function** Develop and use a model to describe the function of a cell as a whole and ways parts of the cells contribute to that function.

Expectation Unwrapped	DOK Ceiling
[Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.]	3
	Item Format
SCIENCE AND ENGINEERING PRACTICES **Developing and Using Models** • Develop and use a model to describe phenomena. **DISCIPLINARY CORE IDEAS** **Structure and Function** • Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. **CROSSCUTTING CONCEPTS** **Structure and Function** • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine function.	Selected Response Constructed Response Technology Enhanced

Content Limits/Assessment Boundaries	Sample Stems

• Tasks should not include the follwoing:
  o Cell parts and functions that are not in the clarification statement
  o Biochemical functions (e.g., enzymes, specific cycles) of cells or cell parts
  o Chemical equations or processes of photosynthesis or cellular respiration
  o Labeling of cellular diagrams ormodels	

Grades 6-8 SCIENCE

Possible Evidence	

• When developing and using a model, students will
    o use brief responses and/or models to show the how a cell controls what enters and leaves a cell in order to maintain the cell's internal processes (e.g., homeostasis) which need energy.
    o identify the key differences between plant and animal cells based on structure and function (e.g., cell walls and chloroplasts).
    o show the movement of molecules through the cell membrane.
    o describe the purpose of organelles, not how the organelles achieve the purpose (e.g., cellular respiration occurs in the mitochondria, photosynthesis occurs in the chloroplast).	

Stimulus Materials Graphic organizers, diagrams, graphs, data tables, drawings	

Grades 6-8 SCIENCE

Life Sciences	6-8.LS1.A.3

Core Idea	From Molecules to Organisms: Structure and Processes
Component	Structure and Function
MLS	Develop an argument supported by evidence for how multicellular organisms are organized by varying levels of complexity: cells, tissue, organs, and organ systems.

Expectation Unwrapped	DOK Ceiling
	3

Expectation Unwrapped	DOK Ceiling / Item Format
[Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.] **SCIENCE AND ENGINEERING PRACTICES** **Engaging in Argument from Evidence** • Use an oral and written arguments supported by evidence to support or refute an explanation or a model for a phenomenon. **DISCIPLINARY CORE IDEAS** **Structure and Function** • In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. **CROSSCUTTING CONCEPTS** **Systems and System Models** • Systems may interact with other systems; they may have subsystems and be a part of larger complex systems. **Science Is a Human Endeavor** • Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas.	**Item Format** Selected Response Constructed Response Technology Enhanced

Grades 6-8 SCIENCE

Content Limits/Assessment Boundaries	Sample Stems
- Tasks should not include the following: - Individual structures and their functions - Recall of parts of body systems (i.e., the circulatory, excretory, digestive, respiratory, muscular, and nervous systems) - Labeling a diagram/model - All evidence for arguments must be provided.	
Possible Evidence	
- When engaging in an argument from evidence, students should reason about the following: - Every scale of body function (e.g., cells, tissues, organs, organs systems) is composed of systems of interacting components - Organs are composed of interacting tissues. Each tissue is made up of specialized cells. These interactions at the cellular and tissue levels enable the organs to carry out specific functions. - A body is a system of specialized organs that interact with each other and their subsystems to carry out the functions necessary for life.	
Stimulus Materials	
Graphic organizers, diagrams, graphs, data tables, drawings	

Grades 6-8 SCIENCE

Life Sciences	6-8.LS1.A.4

Core Idea	From Molecules to Organisms: Structure and Processes
Component	Structure and Function
MLS	Present evidence that body systems interact to carry out key body functions, including providing nutrients and oxygen to cells, removing carbon dioxide and waste from cells and the body, controlling body motion/activity and coordination, and protecting the body.

Expectation Unwrapped	DOK Ceiling
	3

	Item Format
SCIENCE AND ENGINEERING PRACTICES **Engaging in Argument from Evidence** • Use an oral and written argument supported by evidence to support to support or refute an explanation or a model for a phenomenon. **DISCIPLINARY CORE IDEAS** **Structure and Function** • In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. **CROSSCUTTING CONCEPTS** **Systems and System Models** • Systems may interact with other systems; they may have subsystems and be a part of larger complex systems. **Science Is a Human Endeavor** • Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas.	Selected Response Constructed Response Technology Enhanced

Content Limits/Assessment Boundaries	Sample Stems

• Tasks should not include the following:
   o Recall of parts of body systems (circulatory, excretory, digestive, respiratory, muscular, and nervous systems)
   o Specific nutrients the body requires
   o Mechanical and chemical digestion
   o Labeling a diagram/model
• All evidence for arguments must be provided.	

Grades 6-8 SCIENCE

Possible Evidence
 	
• When engaging in an argument from evidence, students should reason about the following:
   ○ Every scale of body function (e.g., cells, tissues, organs, organs systems) is composed of systems of interacting components.
   ○ A body is a system of specialized organs that interact with each other and their subsystems to carry out the functions necessary for life.
• Students should identify reasons different organs can work together to carry out complex function (e.g., the heart contains muscle, connective, and epithelial tissues that allow the heart to receive and pump blood).	

Stimulus Materials Graphic organizers, diagrams, graphs, data tables, drawings	

Grades 6-8 SCIENCE

Life Sciences	6-8.LS1.B.1

Core Idea	From Molecules to Organisms: Structure and Processes
Component	Growth and Development of Organisms
MLS	Construct an explanation for how characteristic animal behaviors as well as specialized plant structures affect the probability of successful reproduction of animals and plants respectively.

Expectation Unwrapped	DOK Ceiling
	3

Expectation Unwrapped

[Clarification Statement: Examples of animal behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of plant behaviors that affect the probability of plant reproduction could include transferring pollen or seeds; and, creating conditions for seed germination and growth. Examples of plant structures that affect the probability of plant reproduction could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.]

SCIENCE AND ENGINEERING PRACTICES
Engaging in Argument from Evidence
- Use an oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

DISCIPLINARY CORE IDEAS
Growth and Development of Organisms
- Animals engage in characteristic behaviors that increase the odds of reproduction.
- Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features of reproduction.

CROSSCUTTING CONCEPTS
Cause and Effect
- Phenomena may have more than one cause, and some cause and effect relationships in systems can be described only by using probability.

DOK Ceiling
3

Item Format
Selected Response
Constructed Response
Technology Enhanced

Grades 6-8 SCIENCE

Content Limits/Assessment Boundaries	Sample Stems
Content Limits/Assessment Boundaries - Tasks should not include the following: - Mathematical computation of equations and/or formulas of probability (qualitiative probabilites can be used) - Recall of mathematical equations and formulas - Natural selection - Symbiotic relationships - Reproductive organs - Plant reproduction - Insect life cycles - Labeling a diagram/model - All evidence for arguments must be provided. **Possible Evidence** - When constructing an explanation, students will - use reasoning and argumentation to show - many characteristic animal behaviors affect the likelihood of successful reproduction. - many specialized plant structures affect the likelihood of successful reproduction. - that sometimes, animal behaviors play a role in the likelihood of successful reproduction in plants. - that because successful reproduction has several causes and contributing factors, the cause and effect relationships between any of these characteristics, separately or together, and reproductive likelihood can be accurately reflected only in terms of probability. - cause and effect relationships between - specialized plant structures and the probability of successful reproduction of plants that have those structures. - animal behaviors and the probability of successful reproduction of animals that exhibit those behaviors. - plant reproduction and the animal behaviors related to plant reproduction. **Stimulus Materials** Graphic organizers, diagrams, graphs, data tables, drawings	**Sample Stems**

Grades 6-8 SCIENCE

Life Sciences	6-8.LS1.B.2

Core Idea	From Molecules to Organisms: Structure and Processes
Component	Growth and Development of Organisms
MLS	Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

Expectation Unwrapped	DOK Ceiling
	3

[Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large-breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.]	**Item Format** Selected Response Constructed Response Technology Enhanced

SCIENCE AND ENGINEERING PRACTICES
Constructing Explanations and Designing Solutions
- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

DISCIPLINARY CORE IDEAS
Growth and Development of Organisms
- Genetic factors as well as local conditions affect the growth of the adult plant.

CROSSCUTTING CONCEPTS
Cause and Effect
- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described only by using probability.

Grades 6-8 SCIENCE

Content Limits/Assessment Boundaries	Sample Stems

Content Limits/Assessment Boundaries
 	
• Tasks should not include the following:
   o The process of inheritance
   o Biochemical processes (e.g., translation and transcription of DNA)
   o Labeling a diagram/model
• All evidence for arguments must be provided.	

Possible Evidence
 	
• Students use reasoning, along with the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future, to connect the evidence and support an explanation for a phenomenon involving genetic and environmental influences on organism growth.
• Students obtain, evaluate, and communicate information that relates the given phenomenon to a scientific idea, including the idea that both environmental and genetic factors influence the growth of organisms.
• Students identify and describe evidence (e.g., from students' own investigations, from observations, from reading material, from archived data) about the following:
   o Environmental factors (e.g., availability of light, space, water, size of habitat) and that they can influence growth
   o Genetic factors (e.g., specific breeds of plants and animals and their typical sizes) and that they can influence growth
   o Changes in the growth of organisms as specific environmental and genetic factors change	

Stimulus Materials Graphic organizers, diagrams, graphs, data tables, drawings	

Grades 6-8 SCIENCE

Life Sciences	6-8.LS1.C.1

Core Idea	From Molecules to Organisms: Structure and Processes
Component	Organization for Matter and Energy Flow in Organisms
MLS	Construct a scientific explanation based on evidence for the role of photosynthesis and cellular respiration in the cycling of matter and flow of energy into and out of organisms.

Expectation Unwrapped	DOK Ceiling
[Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] **SCIENCE AND ENGINEERING PRACTICES** **Constructing Explanations and Designing Solutions** • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future **DISCIPLINARY CORE IDEAS** **Organization for Matter and Energy Flow in Organisms** • Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. **Energy in Chemical Processes and Everyday Life** • The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (e.g., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. **CROSSCUTTING CONCEPTS** **Energy and Matter** • Within a natural system, the transfer of energy drives the motion and/or the cycling of matter.	3
	Item Format Selected Response Constructed Response Technology Enhanced

Grades 6-8 SCIENCE

Content Limits/Assessment Boundaries	Sample Stems
- Tasks should not include the following: - Chemical mechanisms of photosynthesis/cellular respiration (e.g., light and dark cycles) - Recall of photosynthesis equation/cellular respiration - Labeling a diagram/model - All evidence for arguments must be provided. - All chemical equations must be provided.	

Possible Evidence
- Students construct an explanation; obtain, evaluate, and communicate information; and/or engage in an argument from evidence to show understanding of the fact that   - photosynthesis results in the cycling of matter and energy into and out of organisms.   - all food and most of the oxygen animals use for life processes are the results of energy from the sun.   - the process of photosynthesis includes the conversion of carbon dioxide and water into complex carbon-based molecules (sugars) and oxygen; the contribution of sugars to plant growth and internal processes; as well as from plants to other organisms.   - plant, algae, and photosynthetic microorganisms require energy (in the form of sunlight) and must take in carbon dioxide and water to survive.   - energy from sunlight is used to combine simple nonfood molecules (i.e., carbon dioxide and water) into food molecules (i.e., sugar), which can be used immediately or stored by the plant for energy, growth, and other necessary functions (e.g., repair, seed production).   - animals take in food and oxygen to provide energy and materials for growth and survival.   - some animals eat plants, algae, and photosynthetic microorganisms, and some animals eat other animals   - oxygen that was breathed in was released when plants used energy to rearrange carbon dioxide and water during photosynthesis.

Stimulus Materials
Graphic organizers, diagrams, graphs, data tables, drawings

Grades 6-8 SCIENCE

Life Sciences	6-8.LS2.A.1

Core Idea	Ecosystems: Interactions, Energy, and Dynamics
Component	Interdependent Relationships in Ecosystems
MLS	Analyze and interpret data to provide evidence for the effects of resource availability on individual organisms and populations of organisms in an ecosystem.

Expectation Unwrapped	DOK Ceiling
	3

[Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]

Item Format
Selected Response
Constructed Response
Technology Enhanced

SCIENCE AND ENGINEERING PRACTICES
Analyzing and Interpreting Data
- Analyze and interpret data to provide evidence for phenomena.

DISCIPLINARY CORE IDEAS
Interdependent Relationships in Ecosystems
- Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors.
- In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction.
- Growth of organisms and population increases are limited by access to resources.

CROSSCUTTING CONCEPTS
Cause and Effect
- Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Grades 6-8 SCIENCE

Content Limits/Assessment Boundaries	Sample Stems

• Tasks should not include the following:
   ○ Analysis of data beyond given data sets
   ○ Recall of mathematical equations and formulas
   ○ Labeling a diagram/model
   ○ Mathematical computation of equations and/or formulas of probability (qualitiative probabilites can be used)
• All evidence for arguments must be provided.	

Possible Evidence

• Students will analyze and interpret data based on the organization of data (e.g., tables, graphs, charts).
   ○ Examples could include populations (e.g., sizes, reproduction rates, growth information) or organisms as a function of resource availability.
   ○ Examples could include the growth of individual organisms as a function of resource availability.
• Students will analyze the organized data to determine relationships.
• Students will determine whether the relationships provide evidence of a causal link between factors.
   ○ Changes in the amount and availability of a given resource (e.g., less food) may result in changes in the population of an organism (e.g., less food results in fewer organisms) or growth of the individual organism (e.g., more food allows an organism to grow larger)
   ○ Resource availability drives competition among organisms, both within a population as well as between populations, or has an effect on a population's rate of reproduction.

Stimulus Materials
 Graphic organizers, diagrams, graphs, data tables, drawings

Grades 6-8 SCIENCE

Life Sciences	6-8.LS2.A.2

Core Idea	Ecosystems: Interactions, Energy, and Dynamics
Component	Interdependent Relationships in Ecosystems
MLS	Construct an explanation that predicts the patterns of interactions among and between the biotic and abiotic factors in a given ecosystem.

Expectation Unwrapped	DOK Ceiling
	3

[Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]

Item Format
Selected Response
Constructed Response
Technology Enhanced

SCIENCE AND ENGINEERING PRACTICES
Constructing Explanations and Designing Solutions
- Construct an explanation that includes qualitative and quantitative relationships between variables that predict phenomena.

DISCIPLINARY CORE IDEAS
Interdependent Relationships in Ecosystems
- Predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in the competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environment, both living and nonliving, are shared.

CROSSCUTTING CONCEPTS
Patterns
- Patterns can be used to identify cause and effect relationships.

Grades 6-8 SCIENCE

Content Limits/Assessment Boundaries	Sample Stems

Content Limits/Assessment Boundaries
 	
• Tasks should not include the following:
   o Student understanding of specific animal identification/behaviors
   o Analysis of data beyond given data sets
   o Labeling a diagram/model
• All evidence for arguments must be provided.
• Assessment vocabulary should be limited to predation, competition, and symbiosis.	

Possible Evidence
 	
• Students will construct explanations that include qualitative or quantitative relationships between variables that predict cause and effect relationships in ecosystems.
• Students will engage in arguments given from multiple valid and reliable sources.
• Students will analyze and interpret data to predict interactions in an ecosystem
• Students will describe how mutualism, commensalism, and parasitism
   o affects resource availability and can affect interactions between organisms (e.g., organisms in mutually beneficial interactions can become so dependent upon one another that they cannot survive alone).
   o interactions occur across multiple and different ecosystems.	

Stimulus Materials Graphic organizers, diagrams, graphs, data tables, drawings	

Grades 6-8 SCIENCE

Life Sciences	6-8.LS2.B.1

Core Idea	Ecosystems: Interactions, Energy, and Dynamics
Component	Cycles of matter and Energy Transfer in Ecosystems
MLS	Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

Expectation Unwrapped	DOK Ceiling
	3

[Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems and on defining the boundaries of the system.]

Item Format
Selected Response
Constructed Response
Technology Enhanced

SCIENCE AND ENGINEERING PRACTICES
Developing and Using Models
- Develop a model to describe phenomena.

DISCIPLINARY CORE IDEAS
Cycle of Matter and Energy Transfer in Ecosystems
- Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plants or animal matter back into the soil in terrestrial environments or into the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.

CROSSCUTTING CONCEPTS
Energy and Matter
- The transfer of energy can be tracked as energy flows through a natural system.

Scientific Knowledge Assumes an Order and Consistency in Natural Systems
- Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.

Grades 6-8 SCIENCE

Content Limits/Assessment Boundaries	Sample Stems

• Tasks should not include the following:
  o The use of chemical reactions to describe the processes (e.g., how energy moves through an ecosystem, not the specific chemical mechanisms of photosynthesis, cellular respiration, and decomposition)
  o Labeling a diagram/model
• All evidence for arguments must be provided.	

Possible Evidence	

• Students will develop and use a model to describe energy transfers within an ecosystem and matter cycling among producers, consumers, and decomposers and between organisms and nonliving parts of the ecosystem.
• Using the model, students will construct an explanation between components within the ecosystem, including the following:
  o Energy transfer into and out of the system occurs at every level.
  o Energy transfer and matter cycling occurs
    ▪ among producers, consumers, and decomposers (e.g., decomposers break down consumers and producers via chemical reactions and use the energy released from rearranging those molecules for growth and development).
    ▪ between organisms and the nonliving parts of the system (e.g., producers use matter from the nonliving parts of the ecosystem and energy from the sun to produce food from nonfood materials).	

Stimulus Materials	
Graphic organizers, diagrams, graphs, data tables, drawings	

Grades 6-8 SCIENCE

Life Sciences	6-8.LS2.C.1

Core Idea	Ecosystems: Interactions, Energy, and Dynamics
Component	Ecosystems Dynamics, Functioning, and Resilience
MLS	Construct an argument supported by empirical evidence that explains how changes to physical or biological components of an ecosystem affect populations.

Expectation Unwrapped	DOK Ceiling
	3

	Item Format
[Clarification Statement: Emphasis is on recognizing patterns in data and making inferences about changes in populations, defining the boundaries of the system, and on evaluating empirical (quantitative) evidence supporting arguments about changes to ecosystems.] **SCIENCE AND ENGINEERING PRACTICES** **Engaging in Argument from Evidence** • Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomena or a solution to a problem. **Scientific Knowledge Is Based on Empirical Evidence** • Science disciplines share common rules of obtaining and evaluating empirical evidence. **DISCIPLINARY CORE IDEAS** **Ecosystem Dynamics, Functioning, and Resilience** • Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all of its populations. **CROSSCUTTING CONCEPTS** **Stability and Change** • Small changes in one part of a system might cause large changes in another part.	Selected Response Constructed Response Technology Enhanced

Content Limits/Assessment Boundaries	Sample Stems

• Tasks should not include the following:
  o The types and steps of environmental succession
  o Analysis of data beyond given data sets
  o Labeling a diagram/model
  o Mathematical computation of equations and/or formulas of probability (qualitiative probabilites can be used)
• All evidence for arguments must be provided.	

Grades 6-8 SCIENCE

Possible Evidence

- Students obtain, evaluate, and communicate information to describe evidence (e.g., data from scientific literature) regarding
  o changes in the physical or biological components of an ecosystem (e.g., rainfall, fires, predator removal, species introduction) including the magnitude of the changes.
  o changes in the populations of an ecosystem (e.g., population size, types of species present, relative prevalence of a species within the ecosystem) including the magnitude of the changes.
- Students engage in an argument from evidence regarding causal relationships between physical and biological components of an ecosystem and changes in organism populations, based on patterns in the evidence.
- Reasoning in arguments could include the following:
  o Specific changes in the physical or biological components of an ecosystem cause changes that can affect the survival and reproductive likelihood of organisms within the ecosystem (e.g., scarcity of food will alter the survival and reproductive probability of some organisms).
  o Factors that affect the survival and reproduction of organisms can cause changes in the populations of those organisms.
  o Patterns in the evidence suggest that many different types of changes (i.e., changes in multiple types of physical and biological components) are correlated with changes in organism populations.
  o Several consistent correlational patterns, along with the understanding of specific causal relationships between changes in the components of an ecosystem and changes in the survival and reproduction of organisms, suggest that many changes in physical or biological components of ecosystems can cause changes in populations of organisms.
  o Some small changes in physical or biological components of an ecosystem are associated with large changes in a population, suggesting that small changes in one component of an ecosystem can cause large changes in another component.

Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

Grades 6-8 SCIENCE

Life Sciences	6-8.LS2.C.2

Core Idea	Ecosystems: Interactions, Energy, and Dynamics
Component	Ecosystems Dynamics, Functioning, and Resilience
MLS	Evaluate benefits and limitations of differing design solutions for maintaining an ecosystem.

<table>
<tr>
<td>Expectation Unwrapped

[Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]</td>
<td>DOK Ceiling
3</td>
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SCIENCE AND ENGINEERING PRACTICES
Engaging in an Argument from Evidence
- Evaluate competing design solutions based on jointly developed and agreed upon design criteria

DISCIPLINARY CORE IDEAS
Ecosystem Dynamics, Functioning, and Resilence
- Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or intregrity of an ecosystems biodiversity is often used as a measure of its health.
Biodiversity and Humans
- Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on (e.g., water purification and recycling).
Developing Possible Solutions
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.

CROSSCUTTING CONCEPTS
Stability and Change
- Small changes in one part of a system might cause large changes in another part.
Influence of Science, Engineering, and Technology on Society in the Natural World
- The use of technologies and any limitations on their use are driven by individual societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources and economic conditions. Thus, technolgy use varies from region to region over time.
Science Address Questions about the Natural and Material World
- Scientific knowledge can describe the consequences and actions but does not necessarily prescribe the decisions that society takes.

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Item Format
Selected Response
Constructed Response
Technology Enhanced

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Grades 6-8 SCIENCE

Content Limits/Assessment Boundaries	Sample Stems
- Tasks should not include the following: - Steps of design cycles (e.g., scientific method) - Recall of mathematical equations and formulas - Labeling a diagram/model - All evidence for arguments must be provided. - Analysis of benefits and limitations of any design solution should be limited to given data sets	

Possible Evidence

- Students will construct explanations and design solutions for maintaining the biodiversity of an ecosystem.
- Students will engage in arguments from evidence relevant to a problem or design solution. The evaluation of the solutions should include the following:
  - The variety of species found in the given ecosystem
  - The factors that affect biodiversity stability in the given ecosystem
  - The services that affect the stability of the given ecosystem
- Students will
  - compare the ability of each of the competing design solutions to maintain ecosystem stability and biodiversity.
  - clarify the strengths and weaknesses of the competing designs based on scientific, social, and economic considerations.
  - assess possible side effects of the given design solutions on other aspects of the ecosystem (e.g., a small change in one component of an ecosystem producing a large change in another component of the ecosystem).

- See ETS1.A.1 for connection

Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

Grades 6-8 SCIENCE

Life Sciences	6-8.LS4.A.1

Core Idea	Biological Evolution: Unity and Diversity
Component	Evidence of Common Ancestry and Diversity
MLS	Analyze and interpret evidence from the fossil record to infer patterns of environmental change resulting in extinction and changes to life forms throughout the history of the Earth.

Expectation Unwrapped	DOK Ceiling
[Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.] **SCIENCE AND ENGINEERING PRACTICES** **Analyzing and Interpreting Data** • Analyze and interpret data to determine similarities and differences in findings. **Scientific Knowledge is Based on Empirical Evidence** • Science knowledge is based upon logical and conceptual connections between evidence and explanations. **DISCIPLINARY CORE IDEAS** **Evidence of Common Ancestry and Diversity** • The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. **CROSSCUTTING CONCEPTS** **Patterns** • Graphs, charts, and images can be used to identify patterns in data. **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** • Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.	3 **Item Format** Selected Response Constructed Response Technology Enhanced

Grades 6-8 SCIENCE

Content Limits/Assessment Boundaries	Sample Stems
- Tasks should not include the following: - Recall of geological eras in the fossil record - Recall of the names and identification of fossils - Dates of major events (e.g., ice ages, asteroid impacts, volcanic eruptions, organism extinctions/evolutions) - Labeling a diagram/model - Analysis of data beyond given data sets - Mathematical computation of equations and/or formulas - All evidence for arguments must be provided.	

Possible Evidence

- Students will analyze and interpret data (e.g., tables, graphs, charts, images), including the following:
  - The appearance of specific types of fossilized organisms in the fossil record as a function of time, as determined by their locations in the sedimentary layers or the ages of rocks
  - Patterns between sedimentary layers and the relative ages of those layers
  - Time period(s) during which a given fossil organism is present in the fossil record
  - Periods of time for which changes in the presence or absence of large numbers of organisms or specific types of organisms can be observed in the fossil record (e.g., a fossil layer with very few organisms immediately next to a fossil layer with many types of organisms)
  - Patterns of changes in the level of complexity of anatomical structures in organisms in the fossil record, as a function time

Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

Grades 6-8 SCIENCE

Life Sciences	6-8.LS4.B.1

Core Idea	**Biological Evolution; Unity and Diversity**
Component	**Natural Selection**
MLS	Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.

Expectation Unwrapped	DOK Ceiling
	3

	Item Format
[Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations.]	Selected Response
	Constructed Response
	Technology Enhanced

SCIENCE AND ENGINEERING PRACTICES
Constructing Explanations and Designing Solutions
- Construct an explanation that includes qualitative and quantitative relationships between variables that describe phenomena.

DISCIPLINARY CORE IDEAS
Natural Selection
- Natural selection leads to the predominance of certain traits in a population and the suppression of others.

CROSSCUTTING CONCEPTS
Cause and Effect
- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Content Limits/Assessment Boundaries	Sample Stems

- Tasks should not include the following:
  - Mathematical computation of equations, formulas of probability, and/or proportional reasoning
  - Recall of mathematical equations and formulas
  - Labeling a diagram/model
- All evidence for arguments must be provided.

Grades 6-8 SCIENCE

Possible Evidence

- Students will plan and carry out investigations and construct explanations and design solutions in order to obtain, evaluate, and communicate information related to the following:
  - Any population in a given environment contains a variety of available, inheritable genetic traits (i.e. specific variations of a characteristic)
  - For a specific environment (i.e., different environments may have limited food availability, predators, nesting site availability, light availability), some traits confer advantages that make it more probable that an organism will be able to survive and reproduce
  - In a population, there is a cause and effect relationship between the variation of traits and the probability that specific organisms will be able to survive and reproduce
  - Variation of traits is a result of genetic variations occurring in the population
  - The proportion of individual organisms that have genetic variations and traits that are advantageous in a particular environment will increase from generation to generation due to natural selection because the probability that those individuals will survive and reproduce is greater
  - Similarly, the proportion of individual organisms that have genetic variations and traits that are disadvantageous in a particular environment will be less likely to survive, and the disadvantageous traits will decrease from generation to generation due to natural selection

Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

Grades 6-8 SCIENCE

Life Sciences	6-8.LS4.B.2

Core Idea	Biological Evolution; Unity and Diversity
Component	Natural Selection
MLS	Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.

Expectation Unwrapped	DOK Ceiling
[Clarification Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.] **SCIENCE AND ENGINEERING PRACTICES** **Obtaining, Evaluating, and Communicating Information** - Gather, read, and synthesize information from multiple appropriate sources and assess the credibility accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. **DISCIPLINARY CORE IDEAS** **Natural Selection** - In in artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring **CROSSCUTTING CONCEPTS** **Cause and Effect** - Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. **Interdependence of Science, Engineering, and Technology** - Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. **Science Addresses Questions About the Natural and Material World** - Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.	3
	Item Format
	Selected Response Constructed Response Technology Enhanced

Grades 6-8 SCIENCE

Content Limits/Assessment Boundaries	Sample Stems
- Tasks should not include the follwoing: - Recall of specific technologies - Labeling a diagram/model - All evidence for arguments must be provided.	

Possible Evidence

- Students obtain, evaluate, and communicate information about two technologies that have changed the way humans influence the inheritance of desired traits in plants and animals through artificial selection by choosing desired parental traits, which are then often passed on to offspring.
- Students engage in an argument from evidence to
  - assess the credibility, accuracy, and possible bias of each publication and method used in the information gathered.
    - Biased publications could include those by people who make a living through selective breeding (e.g., some farmers) and how those individuals could be biased toward selective breeding.
  - use knowledge and additional sources to describe how the information gathered is or is not supported by evidence.

Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

Grades 6-8 SCIENCE

Life Sciences	6-8.LS4.C.1
Core Idea **Component** **MLS**	**Biological Evolution; Unity and Diversity** **Adaptation** Interpret graphical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.

Expectation Unwrapped	**DOK Ceiling** 3
[Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.] **SCIENCE AND ENGINEERING PRACTICES** **Using Mathematics and Computational Thinking** • Use mathematical representations to support scientific conclusions and design solutions. **DISCIPLINARY CORE IDEAS** **Adaptation** • Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. **CROSSCUTTING CONCEPTS** **Cause and Effect** • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.	**Item Format** Selected Response Constructed Response Technology Enhanced
Content Limits/Assessment Boundaries • Tasks should provide students with all needed equations, formulas, and data sets.	**Sample Stems**

Grades 6-8 SCIENCE

Possible Evidence

- Using math and computational thinking, students identify relevant components, including the following:
  - Population changes (e.g., trends, averages, histograms, graphs, spreadsheets) gathered from historical data or simulations
  - The distribution of specific traits over time from data and/or simulations
  - Environmental conditions (e.g., climate, resource availability) over time from data and/or simulations
  - Changes and trends over time in the distribution of traits within a population
  - Multiple cause and effect relationships between environmental conditions and natural selection in a population
  - The increases or decreases of some traits within a population can have more than one environmental cause
- Students analyze and interpret data as evidence to support the following explanations:
  - Through natural selection, traits that better support survival and reproduction are more common in a population than those traits that are less effective.
  - Populations are not always able to adapt and survive because adaptation by natural selection occurs over generations.
  - Because there are multiple cause and effect relationships contributing to the phenomenon, for each different cause, it is not possible to predict with 100% certainty what will happen.

Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

Grades 6-8 SCIENCE

Engineering, Technology, and Application of Science	6-8.ETS1.A.1

Core Idea	**Engineering Design**
Component	**Defining and Delimiting Engineering Problems**
MLS	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

Expectation Unwrapped	**DOK Ceiling**
	3

	Item Format
SCIENCE AND ENGINEERING PRACTICES **Asking Questions and Defining Problems** • Define a design problem that can be solved through the development of an object, tool, process, or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. **DISCIPLINARY CORE IDEAS** **Defining and Delimiting Engineering Problems** • The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. **CROSSCUTTING CONCEPTS** **Influence of Science, Engineering, and Technology on Society and the Natural World** • All human activity draws on natural resources and has both short- and long-term consequences, positive as well as negative, for the health of people and the natural environment. • The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions.	Selected Response Constructed Response Technology Enhanced

Content Limits/Assessment Boundaries	**Sample Stems**
• Tasks should not require students to identify the exact solution to a given design problem.	

Grades 6-8 SCIENCE

Possible Evidence

- Students describe a problem that can be solved through the development of an object, tool, process, or system.
- Students identify the system in which the problem is embedded, including the major components and relationships in the system and its boundaries, to clarify what is and is not part of the problem. In their definition of the system, students include the following:
  - Which individuals or groups need this problem to be solved
  - The needs that must be met by solving the problem
  - Scientific issues that are relevant to the problem
  - Potential societal and environmental impacts of solutions
  - The relative importance of the various issues and components of the process or system
- Students define criteria that must be taken into account in the solution and that
  - meet the needs of the individuals or groups who may be affected by the problem (including defining who will be the target of the solution).
  - enable comparisons among different solutions, including quantitative considerations when appropriate.
- Students define constraints that must be taken into account in the solution, including the following:
  - Time, materials, and costs
  - Scientific or other issues that are relevant to the problem
  - Needs and desires of the individuals or groups involved that may limit acceptable solutions
  - Safety considerations
  - Potential effects on other individuals or groups
  - Potential negative environmental effects of possible solutions or failure to solve the problem

Stimulus Materials

Graphic organizers, diagrams, graphs, data tables, drawings

Grades 6-8 SCIENCE

Engineering, Technology, and Application of Science	6-8.ETS1.B.1

Core Idea	Engineering Design
Component	Developing Possible Solutions
MLS	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

Expectation Unwrapped	DOK Ceiling
	3

SCIENCE AND ENGINEERING PRACTICES
Engaging in Argument from Evidence
- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.

DISCIPLINARY CORE IDEAS
Developing Possible Solutions
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.

Item Format
Selected Response
Constructed Response
Technology Enhanced

Content Limits/Assessment Boundaries

- Any analysis of data should be limited to given data sets.
- Tasks should provide students with all needed equations, formulas, and data sets.

Sample Stems

Possible Evidence

- Students identify the given supported design solution.
- Students identify scientific knowledge related to the problem and each proposed solution.
- Students identify how each solution would solve the problem.
- Students identify and describe additional evidence necessary for their evaluation, including the following:
  - Knowledge of how similar problems have been solved in the past.
  - Evidence of possible societal and environmental impacts of each proposed solution.
- Students collaboratively define and describe criteria and constraints for the evaluation of the design solution
- Students use a systematic method (e.g., a decision matrix) to identify the strengths and weaknesses of each solution. In their evaluation, students
  - evaluate each solution against each criterion and constraint.
  - compare solutions based on the results of their performance against the defined criteria and constraints.

Grades 6-8 SCIENCE

• Students use the evidence and reasoning to make a claim about the relative effectiveness of each proposed solution based on the strengths and weaknesses of each.
Stimulus Materials Graphic organizers, diagrams, graphs, data tables, drawings

Grades 6-8 SCIENCE

Engineering, Technology, and Application of Science	6-8.ETS1.B.2
Core Idea	**Engineering Design**
Component	**Developing Possible Solutions**
MLS	Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

Expectation Unwrapped	**DOK Ceiling**
	3
SCIENCE AND ENGINEERING PRACTICES **Analyzing and Interpreting Data** • Analyze and interpret data to determine similarities and differences in findings. **DISCIPLINARY CORE IDEAS** **Developing Possible Solutions** • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. • Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. **Optimizing the Design Solution** • Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design.	**Item Format** Selected Response Constructed Response Technology Enhanced
Content Limits/Assessment Boundaries • Any analysis of data should be limited to given data sets • Tasks should provide students with all needed equations, formulas, and data sets.	**Sample Stems**
Possible Evidence • Students organize given data (e.g., tables, charts, graphs) from tests intended to determine the effectiveness of three or more alternative solutions to a problem. • Students use appropriate analysis techniques (e.g., qualitative or quantitative analysis, basic statistical techniques of data and error analysis) to analyze the data and identify relationships within the data sets, including relationships between the design solutions and the given criteria and constraints.	

Grades 6-8 SCIENCE

- Students use the analyzed data to identify evidence of similarities and differences in features of the solutions. - Based on the analyzed data, students make a claim for which characteristics of each design best meet the given criteria and constraints. - Students use the analyzed data to identify the best features in each design that can be compiled into a new (improved) redesigned solution.	
Stimulus Materials Graphic organizers, diagrams, graphs, data tables, drawings	

Grades 6-8 SCIENCE

Engineering, Technology, and Application of Science	6-8.ETS1.B.3

Core Idea	Engineering Design
Component	Developing Possible Solutions
MLS	Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Expectation Unwrapped	DOK Ceiling
	3

	Item Format
SCIENCE AND ENGINEERING PRACTICES **Developing and Using Models** • Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. **DISCIPLINARY CORE IDEAS** **Developing Possible Solutions** • A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. • Models of all kinds are important for testing solutions. **Optimizing the Design Solution** • The iterative process of testing the most promising solutions and modifying that is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.	Selected Response Constructed Response Technology Enhanced

Content Limits/Assessment Boundaries	Sample Stems
• Any analysis of data should be limited to given data sets. • Tasks should provide students with all needed equations, formulas, and data sets.	

Possible Evidence	

• Students develop a model in which they identify the components relevant to testing ideas about the designed system, including the following:
  o The given problem being solved, including criteria and constraints
  o The components of the given proposed solution (e.g., objects, tools, processes) including inputs and outputs of the designed system	

Grades 6-8 SCIENCE

- Students identify and describe the relationships between components, including the following: - The relationships between each component of the proposed solution and the functionality of the solution - The relationship between the problem being solved and the proposed solution - The relationship between each of the components of the given proposed solution and the problem being solved - The relationship between the data generated by the model and the functioning of the proposed solution - Students use the model to generate data representing the functioning of the given proposed solution and each of its iterations as components of the model are modified. - Students identify the limitations of the model with regards to representing the proposed solution. - Students describe how the data generated by the model, along with criteria and constraints that the proposed solution must meet, can be used to optimize the design solution through iterative testing and modification.	
Stimulus Materials Graphic organizers, diagrams, graphs, data tables, drawings	