MS-LS1-4 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.

[Clarification Statement: Examples of 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 animal 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 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	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in Argument from Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Use an oral and written argument 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.	**LS1.B: Growth and Development of Organisms** 3. Animals engage in characteristic behaviors that increase the odds of reproduction. 5. Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction.	**Cause and Effect** • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Assessment Targets

Assessment targets describe the focal knowledge, skills, and abilities for a given three-dimensional Performance Expectation. Please refer to the Introduction for a complete description of assessment targets.

Science and Engineering Subpractice(s)

Please refer to appendix A for a complete list of Science and Engineering Practices (SEP) subpractices. Note that the list in this section is not exhaustive.

7.1 Ability to construct scientific arguments

Science and Engineering Subpractice Assessment Targets

Please refer to appendix A for a complete list of SEP subpractice assessment targets. Note that the list in this section is not exhaustive.

7.1.1 Ability to develop scientific arguments that are supported by evidence/data

7.1.2 Ability to identify evidence/data that supports a claim

7.1.3 Ability to use reasoning to explain how relevant evidence/data supports or refutes the claim; the reasoning should reflect application of scientific concepts, principles, ideas

Disciplinary Core Idea Assessment Targets

LS1.B.3a Recognize that characteristic animal behaviors increase the probability of successful reproduction in animal species that exhibit those behaviors

LS1.B.3b Describe specific animal behaviors involved in reproduction

LS1.B.5a Recognize specialized plant structures that increase the probability of successful reproduction in plant species that have those structures

LS1.B.5b Recognize the animal behaviors that are likely to increase the probability of successful plant reproduction

Crosscutting Concept Assessment Target(s)

CCC2 Identify that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability

Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides data comparing the reproductive success rates of different animals with/without selected behavior(s):

- Identifies patterns in the data and justifies the identification (7.1.1, LS1.B.3, and CCC2)
- Uses the data to support an argument about how a characteristic animal behavior relates to reproductive success in animals that exhibit that behavior (7.1.1, LS1.B.3, and CCC2)

Task provides data/evidence and an argument that a specialized plant structure increases the chances of reproductive success:

- Identifies evidence that is irrelevant/invalid and would not support the argument (7.1.2, LS1.B.5, and CCC2)

Task provides several sources of data/evidence and an argument that a specialized plant structure increases the chances of reproductive success:

- Identifies the evidence that would support the argument (7.1.2, LS1.B.5, and CCC2)

Task provides a claim that animal behaviors can improve the reproductive success of plants:

- Provides a reasoned explanation of data that would support the claim (7.1.3, LS1.B.5, and CCC2)
- Provides examples of animal behaviors and how they can improve the reproductive success of plants (7.1.3, LS1.B.5, and CCC2)

Environmental Principles and Concepts

- EP2: The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies.
- EP4: The exchange of matter between natural systems and human societies affects the long-term functioning of both.

Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

- Courtship behaviors involved in attracting a mate

- Provision of shelter/food/protection from predation for offspring
- Teaching survival skills to offspring
- Flower characteristics that attract birds, bats, and insects for pollination
- Adaptations that facilitate seed dispersal by gravity, wind, water, or animals
- Adaptations that enable seeds to sprout in different environments
- Transporting pollen between flowers
- Transporting seeds to new locations (e.g., carrying seeds, eating fruit, and eliminating seeds)
- Cultivating environments conducive to plant growth

Common Misconceptions

Note that the list in this section is not exhaustive.

- Animal behaviors do not influence the reproductive success of plants.

Additional Assessment Boundaries

None listed at this time.

Additional References

MS-LS1-4 Evidence Statement https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/MS-LS1-4%20Evidence%20Statements%20June%202015%20asterisks.pdf

Environmental Principles and Concepts http://californiaeei.org/abouteei/epc/

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Appendix 1: Progression of the Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts in Kindergarten through Grade 12
https://www.cde.ca.gov/ci/sc/cf/documents/scifwappendix1.pdf

Appendix 2: Connections to Environmental Principles and Concepts
https://www.cde.ca.gov/ci/sc/cf/documents/scifwappendix2.pdf

MS-LS1-6 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

> **Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.**
>
> [Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] *[Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.]*

Continue to the next page for the Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories. • 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. --- ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** • Science knowledge is based upon logical connections between evidence and explanations.	**LS1.C: Organization for Matter and Energy Flow in Organisms** 4. 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. **PS3.D: Energy in Chemical Processes and Everyday Life** 3. The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (*secondary*)	**Energy and Matter** • Within a natural system, the transfer of energy drives the motion and/or cycling of matter.

Assessment Targets

Assessment targets describe the focal knowledge, skills, and abilities for a given three-dimensional Performance Expectation. Please refer to the Introduction for a complete description of assessment targets.

Science and Engineering Subpractice(s)

Please refer to appendix A for a complete list of Science and Engineering Practices (SEP) subpractices. Note that the list in this section is not exhaustive.

6.1 Ability to construct explanations of phenomena

Science and Engineering Subpractice Assessment Targets

Please refer to appendix A for a complete list of SEP subpractice assessment targets. Note that the list in this section is not exhaustive.

6.1.1 Ability to construct a quantitative and/or qualitative explanations of observed relationships

6.1.2 Ability to apply scientific concepts, principles, theories, and big ideas to construct an explanation of a real-world phenomenon

6.1.3 Ability to use models and representations in scientific explanation

Disciplinary Core Idea Assessment Targets

LS1.C.4a Identify organisms that depend on photosynthesis to survive

LS1.C.4b Explain that the process of photosynthesis requires light energy from the Sun

LS1.C.4c Explain that the sugars produced by photosynthesis can be used immediately or stored

LS1.C.4d Explain that oxygen produced by photosynthesis is released and used by animals and plants in respiration

LS1.C.4e Recognize that animals depend (directly or indirectly) on food from photosynthetic organisms for growth and survival

PS3.D.3a Describe how photosynthesis uses energy to form carbon-based organic molecules (i.e., sugars) and oxygen from carbon dioxide and water

Crosscutting Concept Assessment Target(s)

CCC5 Identify that within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter

Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides data from an experiment on plant growth:

- Provides a correct description of the relationships between dependent variables and independent variables (6.1.1, LS1.C.4, and CCC5)

Task describes a real-world scenario of animals getting energy by eating photosynthetic organisms or other animals:

- Explains how the animals' growth and survival depends (indirectly) on sunlight through the application of scientific concepts (e.g., energy flow in ecosystems) (6.1.2, LS1.C.4, and CCC5)

Task provides a model of how oxygen and carbon dioxide are cycled between plants and animals:

- Constructs a correct explanation of the phenomenon. (6.1.3, LS1.C.4, and CCC5)
- Explains the role of plants (or animals) in the cycling of matter (6.1.3, LS1.C.4, and CC5)
- Explains the path of oxygen and carbon dioxide in the cycling of matter (6.1.3, LS1.C.4, and CCC5)

Task describes a real-world scenario about the flow of energy in an ecosystem:

- Draws a model (or drags and drops components to create a model or selects one model from a number of choices) that correctly represents the phenomenon (6.1.3, LS1.C.4, and CCC5)

Environmental Principles and Concepts

- EP2: The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies.
- EP4: The exchange of matter between natural systems and human societies affects the long-term functioning of both.

Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

- Photosynthetic microorganisms
- Photosynthetic organisms using carbon dioxide and water to make sugar and oxygen
- Photosynthetic organisms releasing oxygen
- Animals depending on the oxygen released by photosynthetic organisms for respiration
- Animals returning carbon dioxide to the atmosphere
- Photosynthetic organisms capturing energy from sunlight
- Photosynthetic organisms using captured energy to make sugars
- Photosynthetic organisms releasing oxygen gas
- Photosynthetic organisms using, storing, or modifying the sugars
- Some animals eating photosynthetic organisms for their stored energy
- Some animals eating other animals, thus indirectly getting the energy stored by photosynthetic organisms

Common Misconceptions

Note that the list in this section is not exhaustive.

- Plants take in all substances needed to grow through their roots.
- Plants get energy from the soil.

Additional Assessment Boundaries

None listed at this time.

Additional References

MS-LS1-6 Evidence Statement https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/MS-LS1-6%20Evidence%20Statements%20June%202015%20asterisks.pdf

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MS-LS2-1 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

[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.]

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to provide evidence for phenomena.	**LS2.A: Interdependent Relationships in Ecosystems** 4. Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. 5. 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. 6. Growth of organisms and population increases are limited by access to resources.	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Assessment Targets

Assessment targets describe the focal knowledge, skills, and abilities for a given three-dimensional Performance Expectation. Please refer to the Introduction for a complete description of assessment targets.

Science and Engineering Subpractice(s)

Please refer to appendix A for a complete list of Science and Engineering Practices (SEP) subpractices. Note that the list in this section is not exhaustive.

4.2 Ability to analyze data to identify relationships

Science and Engineering Subpractice Assessment Targets

Please refer to appendix A for a complete list of SEP subpractice assessment targets. Note that the list in this section is not exhaustive.

4.2.1 Ability to use observational and/or empirical data to describe patterns and relationships

4.2.2 Ability to identify patterns (qualitative or quantitative) among variables represented in data

Disciplinary Core Idea Assessment Targets

LS2.A.4a Describe that individual organisms depend on biotic and abiotic factors and the interactions between these factors for survival

LS2.A.4b Describe that populations of organisms are affected by biotic and abiotic factors and the interactions between these factors

LS2.A.5a Describe that competition between individuals of a single species (intraspecific competition) for available resources occurs

LS2.A.5b Describe that competition between individuals from different species (interspecific competition) for available resources occurs

LS2.A.6a Describe that growth of an organism is limited by availability of resources

LS2.A.6b Describe that population growth is limited by availability of resources

Crosscutting Concept Assessment Target(s)

CCC2 Use cause and effect relationships to predict phenomena in natural or designed systems

Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides a data set showing the numbers of individuals in a population during different months of the year:

- Identifies patterns of change (4.2.1, LS2.A.4, and CCC2)

Task provides data on a change in biotic or abiotic factors:

- Describes the change and how it affects organisms in an ecosystem (4.2.1, LS2.A.4, and CCC2)

Task provides a simulation that provides data showing populations of various organisms following a large environmental change (e.g., a forest fire, flooding, etc.):

- Predicts the likely outcome for the organisms following the environmental change (4.2.2, LS2.A.4, and CCC2)

Task provides data comparing population growth when resources are nonlimiting and limiting:

- Describes the differences in the models (4.2.2, LS2.A.6, and CCC2)

- Explains why the models are different (4.2.2, LS2.A.6, and CCC2)

Task provides data for a community before and after the introduction of an invasive species:

- Describes the changes in interspecies competition introduced by the invasive species (4.2.2, LS2.A.5, and CCC2)

Environmental Principles and Concepts

- EP1: The continuation and health of individual human lives and of human communities and societies depend on the health of the natural systems that provide essential goods and ecosystem services.

- EP2: The long-term functioning and health of terrestrial, freshwater, coastal and marine ecosystems are influenced by their relationships with human societies.

- EP3: Natural systems proceed through cycles that humans depend upon, benefit from, and can alter.

- EP4: The exchange of matter between natural systems and human societies affects the long-term functioning of both.

- EP5: Decisions affecting resources and natural systems are based on a wide range of considerations and decision-making processes.

Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

- Habitats with highly limited resources
- Seasonal changes to resource availability
- Introduction of a new species to existing community
- An environmental change that alters resource availability
- Increased competition
- Species with boom and bust cycles

Common Misconceptions

Note that the list in this section is not exhaustive.

- Animals do not compete with others of their species for a limited set of resources (e.g., all the squirrels are friends).
- Since natural resources, like wood and water, are renewable, they cannot be used up and do not limit population growth.
- Plants do not exhibit competition for resources.
- Changes in populations or resource availability only affect resources/organisms that are directly connected in a food chain.

Additional Assessment Boundaries

None listed at this time.

Additional References

MS-LS2-1 Evidence Statement https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/MS-LS2-1%20Evidence%20Statements%20June%202015%20asterisks.pdf

Environmental Principles and Concepts http://californiaeei.org/abouteei/epc/

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MS-LS2-4 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

[Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Construct an oral and written argument 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. --- ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** • Science disciplines share common rules of obtaining and evaluating empirical evidence.	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** 2. 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 its populations.	**Stability and Change** • Small changes in one part of a system might cause large changes in another part.

Assessment Targets

Assessment targets describe the focal knowledge, skills, and abilities for a given three-dimensional Performance Expectation. Please refer to the Introduction for a complete description of assessment targets.

Science and Engineering Subpractice(s)

Please refer to appendix A for a complete list of Science and Engineering Practices (SEP) subpractices. Note that the list in this section is not exhaustive.

7.1 Ability to construct scientific arguments

7.2 Ability to compare, evaluate and critique competing arguments

Science and Engineering Subpractice Assessment Targets

Please refer to appendix A for a complete list of SEP subpractice assessment targets. Note that the list in this section is not exhaustive.

7.1.1 Ability to develop scientific arguments that are supported by evidence/data

7.1.2 Ability to identify evidence/data that supports a claim

7.1.3 Ability to use reasoning to explain how relevant evidence/data supports or refute the claim; the reasoning should reflect application of scientific concepts, principles, ideas

7.2.1 Ability to evaluate arguments about a natural phenomenon based on scientific concepts, principles, and big ideas

7.2.3 Ability to evaluate competing perspectives/claims using reasoning and evidence

Disciplinary Core Idea Assessment Targets

LS2.C.2a Describe changes in the physical or biological components of an ecosystem that can affect populations

LS2.C.2b Identify evidence showing changes in populations of an ecosystem

LS2.C.2c Describe how specific changes in the physical or biological components of an ecosystem can cause changes that can affect the survival of individual organisms within that ecosystem

LS2.C.2d Describe how factors that affect the survival and reproduction of organisms can cause changes in the population of those organisms

LS2.C.2e Describe how a change in a physical or biological component of an ecosystem can cause changes in another component

Crosscutting Concept Assessment Target(s)

CCC7 Identify that small changes in one part of a system might cause large changes in another part

Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides data documenting changes that occurred in a physical/biological component of an ecosystem:

- Constructs or selects an argument that contains an appropriate claim about how the change to a physical/biological component of an ecosystem affects populations within the ecosystem (7.1.1, LS2.C.2, and CCC7)

- Links the evidence/data to a claim about how the change affects populations within the ecosystem (7.1.1, LS2.C.2, and CCC7)

Task provides a claim that changes to a physical/biological components of an ecosystem can affect populations within the ecosystem with supporting evidence/data:

- Identifies the evidence/data supporting the provided claim (7.1.2, LS2.C.2, and CCC7)

- Explains whether or not the provided evidence/data is sufficient to support the claim (7.1.3, LS2.C.2, and CCC7)

- Evaluates the claim demonstrating understanding of scientific concepts and principles (7.2.1, LS2.C.2, and CCC7)

Task provides two competing claims about how the effects of changes occur in a physical/biological components of an ecosystem on populations within the ecosystem, and supporting evidence/data:

- Evaluates the competing claims and explains how the evidence/data supports or does not support the claims (7.2.3, LS2.C.2, and CCC7)

Environmental Principles and Concepts

- EP1: The continuation and health of individual human lives and of human communities and societies depend on the health of the natural systems that provide essential goods and ecosystem services.

- EP2: The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies.
- EP3: Natural systems proceed through cycles that humans depend upon, benefit from, and can alter.
- EP4: The exchange of matter between natural systems and human societies affects the long-term functioning of both.
- EP5: Decisions affecting resources and natural systems are based on a wide range of considerations and decision-making processes.

Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

- Changes in available sunlight
- Changes in temperature patterns
- Changes in precipitation levels
- Changes to soil or water chemistry (fertilizer use, pollution, etc.)
- Human-caused changes to the landscape (dams, roads, farming, etc.)
- Changes in the species present
- Introduction of invasive species or other competitors
- Changes in types of parasites and/or pathogens
- Human-caused changes to the populations (overfishing, release of domestic animals, etc.)

Common Misconceptions

Note that the list in this section is not exhaustive.

- Human intervention is good for an ecosystem.
- Populations exist in states of constant growth.

Additional Assessment Boundaries

None listed at this time.

Additional References

MS-LS2-4 Evidence Statement https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/MS-LS2-4%20Evidence%20Statements%20June%202015%20asterisks.pdf

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