

HS-LS2-2 Ecosystems: Interactions, Energy, and Dynamics

 California Science Test—Item Content Specifications

HS-LS2-2 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

[Clarification Statement: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.] [*Assessment Boundary: Assessment is limited to provided data.*]

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 |
| --- | --- | --- |
| Using Mathematics and Computational ThinkingMathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis; a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms; and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.Use mathematical representations of phenomena or design solutions to support and revise explanations.Connections to Nature of ScienceScientific Knowledge is Open to Revision in Light of New EvidenceMost scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence. | LS2.A: Interdependent Relationships in Ecosystems8. Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.LS2.C: Ecosystem Dynamics, Functioning, and Resilience4. A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. | Scale, Proportion, and QuantityUsing the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. |

## 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.

5.1 Ability to develop mathematical and/or computational models (e.g., graphical representation in a simulation)

5.2 Ability to conduct mathematical and/or computational analyses

### 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.

5.1.1 Ability to generate mathematical representations to describe characteristics and patterns of a scientific phenomenon and/or a design solution

5.2.1 Ability to use the results of computational models (e.g., simulations) to identify patterns in natural and/or design worlds

5.2.2 Ability to use the results of computational models to identify the mathematical and/or computational representations that support a scientific explanation or a design solution

5.2.3 Ability to use computational models (e.g., simulations) to make predictions for a scientific phenomenon

5.2.4 Ability to use critical mathematical skills to compare simulated effects in computational models to real-world observations to identify limitations of computational models

5.2.5 Ability to use mathematical and statistical tools to analyze trends and patterns in data from scientific investigations

### Disciplinary Core Idea Assessment Targets

#### LS2.A.8

* Explain the concept of carrying capacity as it relates to a population, a community, and/or an ecosystem
* Explain the factors that affect carrying capacity
* Describe the impact of a change in environmental conditions on carrying capacity
* Use mathematical comparisons to explain how carrying capacity is affected by a change in one or more factors in an ecosystem
* Use mathematical representations to support claims about factors impacting carrying capacity in an ecosystem
* Explain how population size fluctuates around carrying capacity due to physical and biological dynamics of the ecosystem

#### LS2.C.4

* Explain that under stable conditions, numbers and types of organisms remain relatively constant over time
* Explain that certain disturbances to an ecosystem do not have a lasting effect; the ecosystem is resilient
* Explain that extreme changes to conditions can cause large-scale changes to the ecosystem

### Crosscutting Concept Assessment Target(s)

CCC3 Use the concept of orders of magnitude to understand how a model at one scale relates to a model at another scale

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides data on the population size of one or more species in a particular habitat over time:

* Provides or identifies a graph of the data (5.1.1, LS2.A.8, LS2.C.4, and CCC3)
* Describes patterns in the data (5.2.1, LS2.A.8, LS2.C.4, and CCC3)
* Provides a numerical description of data patterns (5.2.4, LS2.A.8, LS2.C.4, and CCC3)
* Analyzes patterns in the data using mathematical tools, such as mean population change over time (5.2.5, LS2.A.8, LS2.C.4, and CCC3)

Task provides a claim about the ability of a particular ecosystem to support a population of organisms at carrying capacity:

* Predicts how carrying capacity would change with changes in environmental conditions (5.2.2, LS2.A.8, and CCC3)

Task provides a simulation in which population numbers of various species can be manipulated based on available resources or changes in environmental conditions:

* Identifies patterns generated by the results of the simulation (5.2.3, LS2.A.8, LS2.C.4, and CCC3)
* Applies the data from the simulation to predict the impact of changes in resources or environmental conditions on actual populations (5.2.3, LS2.A.8, LS2.C.4, and CCC3)
* Uses the results of the simulation to predict which changes to the ecosystem can be overcome over time and which can lead to permanent changes (5.2.3, LS2.C.4, and CCC3)

## California 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.

* Carrying capacity presented as a mathematical representation that includes trends, averages, and/or impact of environmental change
* Mathematical representations that present changes over time in the numbers and types of organisms in a given ecosystem
* Interactive model to explore biotic and abiotic factors of an ecosystem
* Interactive models that explore the effect of a predator-prey relationship on population stability

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Carrying capacity is a fixed number.
* Populations cannot increase in size beyond their carrying capacities.
* Ecosystems do not change.
* Change in an ecosystem will always decrease the number of individuals who can survive in a population.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-LS2-2 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-LS2-2 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-LS2-2%20Evidence%20Statements%20June%202015%20asterisks.pdf)

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

California Education and the Environment Initiative <http://californiaeei.org/>

The *2016 Science Framework for California Public Schools Kindergarten through Grade 12*

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>

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