

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

California Science Test—Item Content Specifications

# **HS-LS2-1 Ecosystems: Interactions, Energy, and Dynamics**

Students who demonstrate understanding can:

Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

[Clarification Statement: Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets.] [*Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.*]

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 Thinking Mathematical 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 and/or computational representations of phenomena or design solutions to support explanations. | LS2.A: Interdependent Relationships in Ecosystems 8. 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. | Scale, Proportion, and Quantity The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. |

## 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

5.1.2 Ability to use units of measurement, diagrams, and graphs to record and organize data gathered directly or provided from scientific investigations

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
* 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 why populations are not usually maintained at a specific level, but show fluctuations

### Crosscutting Concept Assessment Target(s)

CCC3 Identify that the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs

## 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(s) of one or more species in a particular habitat over time:

* Accurately graphs the data (5.1.1, LS2.A.8, and CCC3)
* Identifies patterns in the data (5.1.2, LS2.A.8, and CCC3)
* Uses mathematical and statistical tools to analyze patterns in the data (5.2.4, LS2.A.8, and CCC3)
* Uses statistical tools to communicate data patterns (5.2.4, LS2.A.8, and CCC3)

Task provides a claim that a population has reached carrying capacity and provides data on the population size of a given species in a particular habitat over time:

* Uses the data to support or refute the claim that the population has reached carrying capacity (5.2.1, LS2.A.8, and CCC3)

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

* Makes a prediction about how carrying capacity can change with changes in environmental conditions (5.2.2, LS2.A.8, and CCC3)

Task provides a simulation in which population sizes can be manipulated based on available resources and/or changes in environmental conditions:

* Uses the results of the simulation to identify patterns (5.2.3, LS2.A.8, and CCC3)
* Uses the results of the simulation to predict the impact of changes in available resources and/or changes in environmental conditions on actual populations (5.2.3, LS2.A.8, and CCC3)
* Uses the results of the simulation to identify limitations of the simulation (5.2.3, LS2.A.8, 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 affected by interspecies competition for resources
* Changes in a population size as a result of biotic and abiotic factors
* Carrying capacity of different species with different niches
* Boom and bust cycles

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Carrying capacity is a fixed number.
* Ecosystems do not change.
* All organisms have a similar carrying capacity.
* Populations cannot increase in size beyond their carrying capacities.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-LS2-1 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-LS2-1 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-LS2-1%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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