Unless otherwise specified, "descriptions" referenced in the evidence statements could include but are not limited to written, oral, pictorial, and kinesthetic descriptions.

HS-LS2-1

Students who demonstrate understanding can:

HS-LS2-1. **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.*]

The performance expectation above was developed using the following elements from *A Framework for K-12 Science Education*:

Science and Engineering Practices

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.

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems

- 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.

Crosscutting Concepts

Scale, Proportion, and Quantity

- The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.

Observable features of the student performance by the end of the course:

1	Representation	
	a	Students identify and describe* the components in the given mathematical and/or computational representations (e.g., trends, averages, histograms, graphs, spreadsheets) that are relevant to supporting given explanations of factors that affect carrying capacities of ecosystems at different scales. The components include:
		i. The population changes gathered from historical data or simulations of ecosystems at different scales; and
		ii. Data on numbers and types of organisms as well as boundaries, resources, and climate.
	b	Students identify the given explanation(s) to be supported, which include the following ideas: Factors (including boundaries, resources, climate, and competition) affect carrying capacity of an ecosystem, and:
		i. Some factors have larger effects than do other factors.
		ii. Factors are interrelated.
		iii. The significance of a factor is dependent on the scale (e.g., a pond vs. an ocean) at which it occurs.
2	Mathematical and/or computational modeling	
	a	Students use given mathematical and/or computational representations (e.g., trends, averages, histograms, graphs, spreadsheets) of ecosystem factors to identify changes over time in the numbers and types of organisms in ecosystems of different scales.

3	Analysis	
	a	Students analyze and use the given mathematical and/or computational representations
		i. To identify the interdependence of factors (both living and nonliving) and resulting effect on carrying capacity; and
		ii. As evidence to support the explanation and identify the factors that have the largest effect on the carrying capacity of an ecosystem for a given population.