



Grades 9–12

3.1.9-12.I Life Science: Interdependent Relationships in Ecosystems

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.

Clarifying 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.

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
<p>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.</p> <ul style="list-style-type: none"> Use mathematical and/or computational representations of phenomena or design solutions to support explanations. 	<p>LS2.A: Interdependent Relationships in Ecosystems</p> <ul style="list-style-type: none"> 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. 	<p>Scale Proportion and Quantity</p> <ul style="list-style-type: none"> The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.

Pennsylvania Context: Examples of Pennsylvania context include but are not limited to possible local connections to Pennsylvania native plants and wildlife populations, and to invasive species such as white-tailed deer, zebra mussels, lanternfly, garlic mustard, and ginkgo plants.

PA Career Ready Skills: Evaluate how societal conventions may influence the perspectives of individuals.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Agriculture (AFNR)	CS.02.02.01.a: Identify and summarize the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).



Standard Source	Possible Connections to Other Standard(s) or Practice(s)
Science, Environmental Literacy and Sustainability (NAEE)	9-12 Strand 2.1.B. Earth's living systems: Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere. 9-12 Strand 3.1.B. Sorting out the consequences of issues: Learners evaluate the consequences of a broad range of environmental changes, conditions, and issues on environmental quality and long-term sustainability. They identify environmental justice and social equity implications.
PA Core Standards: ELA	CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CC.3.5.11-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
PA Core Standards and Practices: Math	MP.2: Reason abstractly and quantitatively. MP.4: Model with mathematics. CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data display. CC.2.1.HS.F.4: Use units as a way to understand problems and to guide the solution of multistep problem. CC.2.4.HS.B.5: Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
PA Standards: Social Studies	N/A
Educational Technology (ISTE)	1.5. Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
Technology and Engineering (ITEEA)	STEL-10: Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.