NEXT GENERATION SCIENCE STANDARDS
For States, By States

HS-LS4-4

Students who demonstrate understanding can:

HS-LS4-4. **Construct an explanation based on evidence for how natural selection leads to adaptation of populations.** [Clarification Statement: Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.]

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

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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.

Disciplinary Core Ideas

LS4.C: Adaptation

- Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not.

Crosscutting Concepts

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.

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

1	Articulating the explanation of phenomena		
	a	Students construct an explanation that identifies the cause and effect relationship between natural selection and adaptation.	
2	Evidence		
	a	Students identify and describe the evidence to construct their explanation, including:	
		i.	Changes in a population when some feature of the environment changes;
		ii.	Relative survival rates of organisms with different traits in a specific environment;
		iii.	The fact that individuals in a species have genetic variation (through mutations and sexual reproduction) that is passed on to their offspring; and
		iv.	The fact that individuals can have specific traits that give them a competitive advantage relative to other individuals in the species.
	b	Students use a variety of valid and reliable sources for the evidence (e.g., theories, simulations, peer review, students' own investigations)	
3	Reasoning		
	a	Students use reasoning to synthesize the valid and reliable evidence to distinguish between cause and correlation to construct the explanation about how natural selection provides a mechanism for species to adapt to changes in their environment, including the following elements:	
		i.	Biotic and abiotic differences in ecosystems contribute to changes in gene frequency over time through natural selection.
		ii.	Increasing gene frequency in a population results in an increasing fraction of the

			population in each successive generation that carries a particular gene and expresses a particular trait.
		iii.	Over time, this process leads to a population that is adapted to a particular environment by the widespread expression of a trait that confers a competitive advantage in that environment.