

HS-LS4-4 Biological Evolution: Unity and Diversity

California Science Test—Item Content Specifications

# HS-LS4-4 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

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.]

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 |
| --- | --- | --- |
| 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. | LS4.C: Adaptation 4. 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. | 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. |

## 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.

6.1 Ability to construct explanations of phenomena

### 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.

6.1.1 Ability to construct quantitative and/or qualitative explanations of observed relationships based on valid and reliable evidence

6.1.2 Ability to apply scientific concepts, principles, theories, and big ideas to construct an explanation of a real-world phenomenon

6.1.3 Ability to use models and representations in scientific explanations

### Disciplinary Core Idea Assessment Targets

#### LS4.C.4

* Identify evidence supporting a claim that natural selection leads to adaptations in populations
* Use a variety of scientifically reliable and valid sources to provide evidence supporting a claim that there is a cause-and-effect relationship between natural selection and adaptation
* Explain that biotic and abiotic factors play a role in natural selection
* Describe that a change in gene frequency over time leads to changes in the frequency of a trait in a population

### Crosscutting Concept Assessment Target(s)

CCC2 Identify empirical evidence to differentiate between cause and correlation and make claims about specific causes and effects

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides data showing a measurable change in the frequency of a trait in a population over time:

* Identifies the cause-and-effect relationship between a change in biotic or abiotic factors and the change in the frequency of the characteristic (6.1.1, LS4.C.4, and CCC2)

Task provides data showing a change in a measurable trait in a population over time:

* Describes how the data allows the distinction between causal and correlational relationships between natural selection and adaptation (6.1.1, LS4.C.4, and CCC2)

Task provides a description of a real-world situation describing changes in biotic or abiotic factors in an ecosystem:

* Uses principles of natural selection to correctly predict how such changes are likely to affect the frequency of particular alleles of a gene over time (6.1.2, LS4.C.4, and CCC2)

Task provides a model showing adaptation in a population in response to a change in a biotic or abiotic factor in an ecosystem:

* Constructs an explanation about the relationship between natural selection and adaptation as shown in the model (6.1.3, LS4.C.4, and CCC2)
* Explains the relationships between the components of the model (6.1.3, LS4.C.4, and CCC2)

Task provides data from an experiment in natural selection, e.g., in a rapidly reproducing organism such as bacteria:

* Develops a model to construct an explanation relating a biotic or abiotic change in the environment of the organism to observed phenotypic or genetic changes in the organism (6.1.3, LS4.C.4, and CCC2)

## California Environmental Principles and Concepts

* EP1: The continuation and health of individual human lives and of human communities and societies depend on the health of the natural systems that provide essential goods and ecosystem services.
* EP2: The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies.

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* Environmental changes that impact the fitness of specific traits in a specific environment
  + Gradual, long-term changes
  + Rapid, extreme environmental changes
* Differential survival and reproduction of organisms within a population attributed to variation in genotype and phenotype
* Ecotypes of a specific species
* Convergence of unrelated species in similar environments

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Selective pressure is constant.
* Adaptations occur quickly, within a couple of generations.
* Individual organisms adapt to changes and pass on those adaptations.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-LS4-4 [Evidence](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-LS4-4%20Evidence%20Statements%20June%202015%20asterisks.pdf) Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-LS4-4 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-LS4-4%20Evidence%20Statements%20June%202015%20asterisks.pdf)

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

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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