

HS-LS4-2 Biological Evolution: Unity and Diversity

California Science Test—Item Content Specifications

# HS-LS4-2 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

[Clarification Statement: Emphasis is on using evidence to explain the influence each of the four factors has on the number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning.] [*Assessment Boundary: Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution*.]

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.B: Natural Selection 4. Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information — that is, trait variation — that leads to differences in performance among individuals. LS4.C: Adaptation 3. Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment’s limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. | Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. |

## 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.B.4

* Describe that there is heritable genetic variation among individuals in a population because of mutations and sexual reproduction
* Describe that genetic variation can lead to a variation of expressed traits in individuals in a population
* Describe that individuals with favorable traits are more likely to survive and reproduce

#### LS4.C.3

* Describe the factors and the interactions among the factors that lead to adaptive evolution by natural selection
* Describe that an increase in population size can lead to competition for limited resources
* Describe that the proportion of individuals in a population with a favorable trait increases over many generations
* Identify heritable traits (behavioral, morphological, physiological) that provide a competitive advantage in a particular environment
* Identify conditions of a particular environment that act as a selective pressure on 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 of dependent and independent variables that may be evidence of evolutionary change in a population:

* Makes a correct quantitative and/or qualitative conclusion regarding the relationships between the variables (6.1.1, LS4.C.3, and CCC2)
* Uses the data to explain a correlational or causal relationship between the variables (6.1.1, LS4.C.3, and CCC2)

Task provides evidence of evolutionary change in a population:

* Uses a scientific concept to explain how the evidence supports a conclusion about the evolutionary change (6.1.2, LS4.C.3, and CCC2)
* Selects a model based on the evidence that best explains the evolutionary change (6.1.3, LS4.C.3, and CCC2)

Task provides a mathematical model of evolutionary change in a population:

* Uses the model to make a prediction about an evolutionary change (6.1.3, LS4.C.3, and CCC2)
* Uses the model to construct an explanation of the evolutionary change (6.1.3, LS4.C.3, 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.

* Mathematical models showing changes in allele frequency over time
* Graphs showing variation in a particular feature over a geographic area
* Data showing an increase in the frequency of a particular phenotype in a population
* Identification of the different selective pressures that affect the trait distribution among two different isolated populations of a species

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Evolution is a directed process.
* Mutations are always bad.
* The strongest individuals survive.
* New adaptations are the results of the efforts of individual organisms.
* Humans are exempt from evolution.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-LS4-2 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-LS4-2 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-LS4-2%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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