

HS-LS4-6 Biological Evolution: Unity and Diversity

California Science Test—Item Content Specifications

# HS-LS4-6 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

[Clarification Statement: Emphasis is on designing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.]

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 |
| --- | --- | --- |
| 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.  Create or revise a simulation of a phenomenon, designed device, process, or system. | LS4.C: Adaptation  1. Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline — and sometimes the extinction — of some species. | Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. |
| Continuation of the previous row:  Not applicable | Continuation of the previous row: LS4.D: Biodiversity and Humans 5. Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. *(Note: This Disciplinary Core Idea is also addressed by HS-LS2-7.)* ETS1.B: Developing Possible Solutions 10. When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. *(secondary to HS-LS4-6)*  11. Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. *(secondary to HS-LS4-6)* | Continuation of the previous row:  Not applicable |

## 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.

5.1 Ability to develop mathematical and/or computational models (e.g., graphical representation in a simulation)

5.2 Ability to conduct mathematical and/or computational analyses

### 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.

5.1.1 Ability to generate mathematical representations to describe characteristics and patterns of a scientific phenomenon and/or a design solution

5.1.3 Ability to create, evaluate, and/or revise a computational model or simulation of a scientific phenomenon, a design solution, or both

5.1.4 Ability to recognize that computational models such as simulations are built on mathematical models that incorporate the underlying science principles being studied

5.2.3 Ability to use computational models (e.g., simulations) to make predictions of a scientific phenomenon

### Disciplinary Core Idea Assessment Targets

#### LS4.C.6

* Identify naturally occurring changes in the physical environment that result in population changes in species, especially in the size or genetic diversity of the populations
* Identify human-induced changes in the physical environment that result in population changes in other species, especially in the size or genetic diversity of the populations

#### LS4.D.5

* Identify human activities that are having an adverse effect on biodiversity
* Describe how sustaining biodiversity helps to maintain ecosystems
* Describe how sustaining biodiversity aids the human population
* Create or revise a simulation that models the effect of human activity on a threatened or endangered species

#### ETS1.B.10

* Use a simulation to show understanding of the reliance of ecosystem function and productivity on biodiversity
* Evaluate proposed solutions to mitigating human-induced loss of biodiversity, weighing likely constraints such as the economic cost of the solutions and the social and cultural impact of the solutions against the successful implementation of the solutions

#### ETS1.B.11

* Describe a complex real-world problem with criteria and constraints from a given computer simulation
* Identify the system being modeled by a computer simulation

### Crosscutting Concept Assessment Target(s)

CCC2 Identify empirical evidence to differentiate between cause and correlation and to 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 alternative computational models that include graphs or tables of the population sizes of one or several native species over time as habitat is damaged by human activity and then restored:

* Evaluates the data to select the model that best predicts the number of years until the species population sizes return to pre-damage levels (5.1.3, LS4.C.6, and CCC2)

Task provides a computational model that is (or will be) the basis for a simulation of the effects of reducing carbon emissions or an aspect of global climate change (such as increasing ocean acidity) on an ecosystem:

* Identifies a way by which the model can be revised for improved accuracy of prediction so that the model can be used to persuade governments or industries to reduce emissions (5.1.4, LS4.C.6, ETS1.B.11, and CCC2)

Task provides a simulation (aligned with forest replanting to mitigate human activity) for calculating CO2 sequestration rates of several forests: one with all healthy growing trees, one with a portion of trees that are dying, perhaps as the result of pollution, and one that is reduced to felled trees on the ground:

* Manipulates variables on sliders (e.g., representing proportion of live trees, rates of photosynthesis, and rate of cellular respiration) to calculate the CO2 sequestration rate in each forest (5.2.2, LS4.C.6, and CCC2)

Task provides two solutions by which aquatic organisms whose population sizes have been greatly reduced can be restored to earlier levels, such as removal of a dam vs. restocking juvenile populations:

* Manipulates variables on sliders (e.g., representing cost, initial quantity of food source for fish, oxygenation of a stream, water temperature) to test which solution is likely to be more effective considering a range of constraints (5.2.2, LS4.C.6, ETS1.B.10, 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.

* The use of certain polluting herbicides and pesticides
* The destruction of habitat for development
* The degree of global climate change
* Reintroduction of endangered native species
* Construction of wildlife bridges in areas that have many highways

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Humans can only decrease biodiversity.
* Humans cannot affect biodiversity.
* Humans are not affected by biodiversity; humans are separate from the rest of the environment.
* Computational models are certain, rather than probabilistic.
* Computational models are comprehensive and contain all factors.
* All organisms will adopt perfect solutions to new environments.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-LS4-6 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-LS4-6 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-LS4-6%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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