

HS-LS2-5 Ecosystems: Interactions, Energy, and Dynamics

California Science Test—Item Content Specifications

# HS-LS2-5 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

[Clarification Statement: Examples of models could include simulations and mathematical models.] [*Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and respiration.*]

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 |
| --- | --- | --- |
| Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).  Develop a model based on evidence to illustrate the relationships between systems or components of a system. | LS2.B: Cycles of Matter and Energy Transfer in Ecosystems 5. Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. PS3.D: Energy in Chemical Processes 5. The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. *(secondary to HS-LS2-5)* | Systems and System Models Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions — including energy, matter and information flows — within and between systems at different scales. |

## 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.

2.1 Ability to develop models

### 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.

2.1.1 Ability to determine components of a scientific event, system, or design solution

2.1.2 Ability to determine the relationships among multiple components of a scientific event, system, or design solution

2.1.3 Ability to determine scope, scale, and grain-size of models, as appropriate for their intended use

2.1.4 Ability to represent mechanisms, relationships, and connections to illustrate, explain, or predict a scientific event

### Disciplinary Core Idea Assessment Targets

#### LS2.B.5

* Identify the relevant chemical components (reactants and products) of photosynthesis and cellular respiration
* Identify the sources and reservoirs of carbon in the biosphere, atmosphere, hydrosphere, and geosphere
* Describe the relative importance (with respect to amount of carbon stored and accessibility/rate of turnover) of the reservoirs of carbon in the biosphere, atmosphere, hydrosphere, and geosphere
* Identify the roles played by both terrestrial and aquatic organisms in the storage of carbon and the addition of carbon to the biosphere, atmosphere, hydrosphere, and geosphere
* Describe factors that affect the ratio of removal of carbon from the atmosphere by photosynthesis to the addition of carbon to the atmosphere by cellular respiration, burning of fossil fuels and wood, and other human activities
* Predict the effect on the carbon cycle of altering the size of specific carbon sources or reservoirs

#### PS3.D.5

* Identify that solar energy is captured and transformed to chemical energy by photosynthesis
* Describe that the chemical energy produced by photosynthesis is in the form of carbon-based sugars that are stored in plants

### Crosscutting Concept Assessment Target(s)

CCC4 Use models to simulate systems and interactions with and between systems at different scales

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides an incomplete model of the carbon cycle:

* Completes the model (2.1.1, LS2.B.5, and CCC4)
* Describes relationships of the components to illustrate the roles of photosynthesis and cellular respiration in the carbon cycle (2.1.1, LS2.B.5, and CCC4)

Task provides an incomplete model of a simple biological system that illustrates the roles of photosynthesis and/or cellular respiration:

* Completes the model (2.1.1, LS2.B.5, PS3.D.5, and CCC4)
* Describes the components of the model (inputs, outputs, organisms, and processes) (2.1.1, LS2.B.5, PS3.D.5, and CCC4)
* Describes the relationships among the components (2.1.1, LS2.B.5, PS3.D.5, and CCC4)

Task provides complete models representing a particular aspect of the cycling and exchange of carbon at different scales (e.g., molecular, cellular, organismal, ecosystem, atmosphere, hydrosphere, geosphere):

* Selects the model with the relative scale and size of the components appropriate to represent the scale of the model’s intended use (2.1.2, LS2.B.5, and CCC4)

Task provides a scientific phenomenon or event related to the role of photosynthesis and/or cellular respiration in the carbon cycle:

* Predicts an outcome using appropriate labels and/or representations to represent the process(es) involved (2.1.3, LS2.B.5, and CCC4)

## California Environmental Principles and Concepts

* EP2: The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies.
* EP4: The exchange of matter between natural systems and human societies affects the long-term functioning of both.

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* The effects of human activity (such as logging, industrialization, etc.) on the biosphere, atmosphere, hydrosphere, and geosphere
* The effects of carbon in the atmosphere or geosphere on oceans and marine organisms
* The role of sunlight in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere
* Quantitative study of carbon sinks and sources

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Plants only undergo cellular respiration in the dark.
* Plants do not require oxygen for cellular respiration.
* Cellular respiration is the same as breathing.
* Cellular respiration produces energy rather than converting chemical energy from one form to another.
* Energy cycles within an ecosystem.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-LS2-5 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-LS2-5 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-LS2-5%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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