

HS-ESS2-7 Earth’s Systems

California Science Test—Item Content Specifications

# HS-ESS2-7 Earth’s Systems

Students who demonstrate understanding can:

Construct an argument based on evidence about the simultaneous coevolution of Earth’s systems and life on Earth.

[Clarification Statement: Emphasis is on the dynamic causes, effects, and feedbacks between the biosphere and Earth’s other systems, whereby geoscience factors control the evolution of life, which in turn continuously alters Earth’s surface. Examples include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants; or how the evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for the evolution of new life forms.] [*Assessment Boundary: Assessment does not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of Earth’s other systems.*]

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 |
| --- | --- | --- |
| Engaging in Argument from Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.  Construct an oral and written argument or counter-arguments based on data and evidence. | ESS2.D: Weather and Climate  1. Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen.  ESS2.E Biogeology  1. The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual coevolution of Earth’s surface and the life that exists on it. | Stability and Change Much of science deals with constructing explanations of how things change and how they remain stable. |

## 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.

7.1 Ability to construct scientific arguments

7.2 Ability to compare, evaluate, and critique competing arguments

### 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.

7.1.1 Ability to identify evidence/data that supports a claim

7.1.2 Ability to develop scientific arguments that are supported by evidence/data

7.1.3 Ability to use reasoning to explain how relevant evidence/data supports or refutes the claim; the reasoning should reflect application of scientific concepts, principles, ideas, and models

7.2.3 Ability to evaluate competing perspectives/claims using reasoning and evidence

### Disciplinary Core Idea Assessment Targets

#### ESS2.D.8

* Describe the evidence that suggests Earth had particular atmospheric or geologic features in the past
* Describe the evidence for the presence of particular organisms on Earth in the past
* Compare features of the modern atmosphere (e.g., gas concentrations) on Earth to that of the atmosphere in the past in order to identify similarities, differences, and the rate at which those differences occurred
* Identify biological mechanisms (e.g., photosynthesis, nitrogen fixation, cellular respiration, etc.) that impact Earth systems
* Identify evidence that supports claims regarding the coevolution of Earth’s systems and organisms (e.g., the emergence of photosynthetic organisms and free oxygen in Earth’s atmosphere)

#### ESS2.E.3

* Describe how changes to life on Earth could alter existing atmospheric or geologic systems
* Describe how changes to Earth’s geologic or atmospheric systems could alter (positively or negatively) the presence of certain forms of life on Earth

### Crosscutting Concept Assessment Target(s)

CCC7 Construct explanations of how things change and how they remain stable

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task presents students with data about the atmospheric concentration of oxygen and the history of life on Earth:

* Constructs an argument that contains a claim, evidence, and the reasoning that links the evidence to the claim that the evolution of photosynthetic organisms led to an increase in atmospheric oxygen (7.1.1, ESS2.D.8, and CCC7)

Task presents students with information and a claim about various microbial organisms and rates of soil formation:

* Explains whether the provided evidence is sufficient to defend the claim (7.1.2, ESS2.D.8, and CCC7)

Task presents students with a claim based on the idea that the evolution of life on land was influenced by increasing atmospheric oxygen levels:

* Identifies pieces of evidence that support the claim (7.1.2, ESS2.D.8, and CCC7)

Task presents students with a claim that the change in erosion and deposition along a coastline was a result of the growth of a coral reef:

* Provides reasoning that links the evidence and claim, and reflects an application of a scientific concept, principle, or big idea (7.1.3, ESS2.D.8, and CCC7)

Task presents various pieces of evidence linking evolution to changes in Earth’s systems:

* Identifies possible evidence and reasoning that can be used to justify different perspectives or claims (7.2.3, ESS2.E.3, and CCC7)

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* Timelines of the changes in geologic structures and the evolution of living things
* Data on the concentration of atmospheric oxygen over time and the presence of photosynthetic organisms
* The presence of different microbes (and other living organisms) in soil samples depending on features of the soil
* The atmospheric and other environmental conditions leading to the formation of coal, banded iron formations, and other materials
* Evidence in the geologic record showing the effect of atmospheric gases on biological systems, such as elevated oxygen levels in the atmosphere that may have helped the survival of very large insects

## Common Misconceptions

Note that the list in this section is not exhaustive.

* The composition of the atmosphere does not change over time.
* Plants do not use oxygen.
* Organisms cannot impact the atmosphere, the oceans, or soil formation.
* Organisms do not change over time.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-ESS2-7 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-ESS2-7 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-7%20Evidence%20Statements%20June%202015%20asterisks.pdf)

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>

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