

HS-ESS2-2 Earth’s Systems

California Science Test—Item Content Specifications

# HS-ESS2-2 Earth’s Systems

Students who demonstrate understanding can:

Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

[Clarification Statement: Examples should include climate feedbacks, such as how an increase in greenhouse gases causes a rise in global temperatures that melts glacial ice, which reduces the amount of sunlight reflected from Earth's surface, increasing surface temperatures and further reducing the amount of ice. Examples could also be taken from other system interactions, such as how the loss of ground vegetation causes an increase in water runoff and soil erosion; how dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion; or how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.]

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 |
| --- | --- | --- |
| Analyzing and Interpreting Data Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.  Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. | ESS2.A: Earth Materials and Systems  1. Earth’s systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes.  ESS2.D: Weather and Climate The foundation for Earth’s global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy’s re-radiation into space. | Stability and Change Feedback (negative or positive) can stabilize or destabilize a system.  Connections to Engineering, Technology, and Applications of Science Influence of Engineering, Technology, and Science on Society and the Natural World New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. |

## Assessment Targets

Assessment targets describe the focal knowledge, skills, and abilities for a given three-dimensional Performance Expectation. Please refer to the Introduction (hyperlink to section on explanation of assessment targets) 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.

4.2 Ability to analyze data to identify relationships

### 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.

4.2.1 Ability to use empirical data to describe patterns and relationships

4.2.2 Ability to identify patterns (qualitative or quantitative) among variables represented in data

4.2.3 Ability to apply concepts of statistics and probability to data

4.2.4 Ability to consider limitations of data analysis (e.g., measurement error, sample selection)

### Disciplinary Core Idea Assessment Targets

#### ESS2.A.6

* Identify and describe mechanisms for the feedbacks between two Earth systems and whether the feedback is positive or negative, increasing (destabilizing) or decreasing (stabilizing) the original changes.
* Identify and describe the unintended effects of human activity and specific technologies on Earth’s systems
* Identify and describe the relationship between changes in one Earth system and another Earth system or changes within the same system

#### ESS2.D.7

* Identify and describe the electromagnetic spectrum from the Sun as the foundation of global climate systems
* Describe the reflection, storage, and redistribution of the electromagnetic radiation from the Sun among the atmosphere, hydrosphere, and geosphere
* Describe the reradiation of the electromagnetic radiation from the Sun back into space

### Crosscutting Concept Assessment Target(s)

CCC7 Identify feedback, both positive and negative, that can stabilize or destabilize a system.

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides a scenario involving changes to one or more Earth systems as a result of natural processes or human activity and a data display:

* Describes the patterns or relationships in the data set (4.2.1, ESS2.A.6, and CCC7)

Task provides a scenario involving changes to one or more Earth systems as a result of natural processes or human activity and a data display:

* Identifies the patterns or relationships among the variables represented in the data (4.2.2, ESS2.A.6, and CCC7)

Task provides a scientific question about changes to one or more Earth systems as a result of natural processes or human activity and a data display:

* Analyzes the data using reasoning, mathematics, or statistics and probability (including mean, median, mode, and variability) to answer the scientific question (4.2.3, ESS2.A.6, and CCC7)
* Identifies the limitations of data sets or analyses with respect to their ability to answer the scientific question (4.2.4, ESS2.D.7, and CCC7)

## California Environmental Principles and Concepts

* EP3: Natural systems proceed through cycles that humans depend upon, benefit from, and can alter.
* 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.

* Relationship between climate change and human activity (e.g., greenhouse gas release leads to increased surface temperatures)
* Effect of large-scale deforestation on climate change, groundwater recharge, or erosion
* Effect of reservoir creation on groundwater recharge, sediment transport, or coastal erosion
* Effect of human activity and natural processes on the cycling of carbon or nitrogen in Earth systems

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Climate change is only caused by human activities.
* Short-term anomalies in data are evidence for or against long-term trends.
* Small changes in Earth’s systems have no significant long-term effects**.**

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-ESS2-2 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-ESS2-2 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-2%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>

Posted by the California Department of Education, March 2021 (updated February 2024)