

HS-ESS3-6 Earth and Human Activity

California Science Test—Item Content Specifications

**HS-ESS3-6 Earth and Human Activity**

Students who demonstrate understanding can:

Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

[Clarification Statement: Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. An example of the far-reaching impacts from a human activity is how an increase in atmospheric carbon dioxide results in an increase in photosynthetic biomass on land and an increase in ocean acidification, with resulting impacts on sea organism health and marine populations.] [*Assessment Boundary: Assessment does not include running computational representations but is limited to using the published results of scientific computational models.*]

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.  Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations. | ESS2.D: Weather and Climate  1. Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. *(secondary to HS-ESS3-6)*  ESS3.D: Global Climate Change  1. Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. | Systems and System Models When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. |

## 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.

5.2 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.

5.2.1 Ability to use the results of computational models (e.g., simulations) to identify patterns in natural and/or design worlds

5.2.2 Ability to use the results of computational models to identify the mathematical and/or computational representations that support a scientific explanation or a design solution

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

5.2.4 Ability to use critical mathematical skills to compare simulated effects in computational models to real-world observations to identify limitations of computational models

### Disciplinary Core Idea Assessment Targets

#### ESS2.D.11

* Identify evidence in mathematical and/or computational models showing how Earth systems are being modified by human activity
* Differentiate changes in weather or climate attributable to human activities from those attributable to natural processes (e.g., changes in solar activity or volcanism)
* Identify relevant relationships that should be included in a model predicting Earth’s future climate including sources and sinks of greenhouse gases
* Differentiate between the effects of different human activities on Earth’s climate
* Describe the role that various assumptions about future human activities have on our predictions of future climate/weather
* Describe the role of measures of “initial conditions” in making predictions of future climate or weather

#### ESS3.D.3

* Describe modern barriers to making accurate predictions of future climate or weather patterns
* Identify areas of uncertainty that exist in modern scientific understanding of the relationships between Earth systems
* Identify areas of uncertainty that exist in modern scientific understanding of future trends in human activity

### Crosscutting Concept Assessment Target(s)

CCC4 Identify that the boundaries and initial conditions of the system need to be defined when investigating or describing a system

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides the results of a computational model or simulation showing the effect human activity is having on preexisting relationships between Earth systems:

* Uses the results of the models to identify the mathematical and/or computational representations supporting a scientific explanation of the relationships (5.2.1, ESS2.D.11, and CCC4)

Task provides a computational model or simulation showing the effect human activity is having on preexisting relationships between Earth systems:

* Makes a prediction about global climate change based on the combination of variables in the simulation (5.2.2, ESS3.D.3, and CCC4)
* Evaluates the assumptions and simplifications of the simulation (5.2.3, ESS2.D.11, and CCC4)
* Identifies the limitations of the simulation in making accurate predictions (5.2.3, ESS2.D.11, and CCC4)
* Identifies areas of uncertainty in the predictions generated from the model or simulation (5.2.3, ESS2.D.11, and CCC4)
* Uses statistical tools to compare simulated effects in the models to real-world observations (5.2.4, ESS2.D.11, and CCC4)

## 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.
* 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.
* EP5: Decisions affecting resources and natural systems are based on a wide range of considerations and decision-making processes.

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* Effect of increases in global or local ocean temperatures on marine life
* Effect of decreases in available freshwater resources on organisms
* Acidification of surface waters due to increased carbon concentrations in the hydrosphere and atmosphere
* Changes in precipitation trends due to increases in ocean temperature and increases in sea level
* Relationship between the amount of CO2 emissions and amount of Arctic Sea ice

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Interactions between human activity and Earth systems are always negative.
* Interactions between human activity and Earth systems involve a single sequence of causes and effects rather than a complex system in which multiple interactions happen simultaneously.
* Changes to Earth systems will not affect people.
* The effects of human activities on Earth systems can only be felt in the long term.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-ESS3-6 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-ESS3-6 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS3-6%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>

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