

HS-ESS3-5 Earth and Human Activity

California Science Test—Item Content Specifications

**HS-ESS3-5 Earth and Human Activity**

Students who demonstrate understanding can:

Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

[Clarification Statement: Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).] [*Assessment Boundary: Assessment is limited to one example of a climate change and its associated impacts.*]

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 computational models in order to make valid and reliable scientific claims.  Connections to Nature of Science Scientific Investigations Use a Variety of Methods Science investigations use diverse methods and do not always use the same set of procedures to obtain data.  New technologies advance scientific knowledge. Scientific Knowledge is Based on Empirical Evidence Science knowledge is based on empirical evidence.  Science arguments are strengthened by multiple lines of evidence supporting a single explanation. | ESS3.D: Global Climate Change  1. Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. | Stability and Change Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. |

## 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.

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

#### ESS3.D.2

* Describe the key outputs of climate models
* Identify the meaning and utility of key inputs to computational climate change models (including sources of anthropogenic greenhouse gases and how those sources have changed over time)
* Describe how scientists develop and use climate models to make predictions about future impacts of human-driven and non-human-driven climate changes
* Describe how the explanatory and predictive power of climate models has improved with improved data collection and modelling methods
* Describe a selected aspect of present or past climate and the associated physical parameters (e.g., temperature, precipitation, and sea level) or chemical composition (e.g., ocean pH) of the atmosphere, geosphere, hydrosphere, or cryosphere
* Describe if the predicted changes on Earth systems are reversible or irreversible
* Identify sources of uncertainty in the prediction of the effect of the future of a selected aspect of climate change

### Crosscutting Concept Assessment Target(s)

CCC7 Develop models that quantify change and rates of change over very short to very long periods of time and recognize irreversible changes

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides data presenting changes in human activity and physical features of the climate over a meaningful timespan:

* Describes the correlation between the graphs (4.2.1, ESS3.D.2, and CCC7)
* Describes the patterns in the data over time (4.2.1, ESS3.D.2, and CCC7)

Task presents student with data showing physical parameters (e.g., temperature, precipitation, sea level) and changes in range of a given species:

* Identifies the patterns between the variables represented in the data (4.2.2, ESS3.D.2, and CCC7)

Task provides student with data/graph of climate observations over time:

* Predicts changes to the Earth’s systems based on probability (4.2.3, ESS3.D.2, and CCC7)
* Predicts if the changes are reversible or irreversible (4.2.3, ESS3.D.2, and CCC7)

Task provides data displaying atmospheric climatological data sets over time:

* Identifies the limitations of the graphs in investigating the role of humans in climate change (4.2.4, ESS3.D.2, and CCC7)

## 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.

* Sources of uncertainty in climate change predictions
* Graphs of carbon emissions from human activities, atmospheric carbon dioxide levels, and global temperatures over time
* Melting of ice caps leading to changing sea levels and surface albedo
* Changes in frequency, intensity, location of storms, droughts, wildfires or other weather-related events
* Changes in the chemical composition of the ocean or atmosphere

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Climate change is only the result of anthropogenic factors.
* Climate change models cannot predict changes to physical parameters or chemical composition of the atmosphere, geosphere, hydrosphere, or cryosphere.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-ESS3-5 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-ESS3-5 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS3-5%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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