

HS-ESS3-3 Earth and Human Activity

California Science Test—Item Content Specifications

**HS-ESS3-3 Earth and Human Activity**

Students who demonstrate understanding can:

Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

[Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.] [*Assessment Boundary: Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.*]

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.  Create a computational model or simulation of a phenomenon, designed device, process, or system. | ESS3.C: Human Impacts on Earth Systems   1. The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. | 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.  Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World Modern civilization depends on major technological systems.  New technologies can have deep impacts on society and the environment, including some that were not anticipated.  Connections to Nature of Science Science is a Human Endeavor Science is a result of human endeavors, imagination, and creativity. |

## 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.

5.1 Ability to develop mathematical and/or computational models (e.g., graphical representation in a simulation)

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.

5.1.1 Ability to generate mathematical representations to describe characteristics and patterns of a scientific phenomenon and/or a design solution

5.1.2 Ability to use units of measurement, diagrams, and graphs to record and organize data gathered directly or provided from scientific investigations

5.1.3 Ability to create, evaluate, and/or revise a computational model or simulation of a scientific phenomenon, a design solution, or both

5.1.4 Ability to recognize that computational models such as simulations are built on mathematical models that incorporate the underlying science principles being studied

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

#### ESS3.C.5

* Quantify and describe linear and non-linear relationships among resource management, sustainability of human populations, and biodiversity
* Identify ways in which introduction of technology has altered pre-existing relationships among resource management, sustainability of human populations, and biodiversity
* Identify ways in which alterations in resource management, sustainability of human populations, or biodiversity can be resisted by negative feedback loops or exacerbated by positive feedback loops
* Identify differential relationships among resource management, sustainability of human populations, and biodiversity including differential rates of change and differential impacts on Earth’s environment

### 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 about the ecological footprint for various human populations:

* Uses diagrams and/or graphs to correctly record and organize data on ecological footprints to compare various populations (5.1.2, ESS3.C.5, and CCC7)

Task provides data on changes in the size of human populations and changes in biodiversity in a given area:

* Develops mathematical models using given data that correctly show relationships between population size and biodiversity (5.1.3, ESS.C.5, and CCC7)

Task provides a computational model or simulation showing the relationships between resource management, human population size, and/or biodiversity:

* Evaluates the model/simulation to determine if it meets the goal (5.1.3, ESS3.C.5, and CCC7)
* Identifies the mathematical principles that are relevant to the computational model or simulation (5.1.4, ESS3.C.5, and CCC7)
* Identifies a pattern contained in the data from the simulation (5.2.3, ESS3.C.5, and CCC7)
* Uses statistical tools to compare simulated effects in the models to real-world observations to identify limitations of simulations (5.2.4, ESS3.C.5, and CCC7)

Task provides the results of a computational model or simulation showing the relationships between resource management, human population size, and biodiversity:

* Identifies the mathematical and/or computational representations supporting a scientific explanation of the relationships (5.2.1, ESS3.C.5, and CCC7)
* Makes a correct prediction based on the combination of variables in the simulation about the relationships (5.2.2, ESS3.C.5, 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.

* Analysis of global human population growth and impact on natural systems (e.g., changes in biodiversity or animal behavior)
* Calculation of ecological footprints
* Evaluation of various natural resource management systems
* Evaluation of the environmental impact of plans for urban development or waste management
* Evaluation of the effect of adding or removing data from a simulation

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Human population size is not an environmental problem.
* Exponential human population growth is not linked to depletion of resources.
* Population structure is the same all over Earth.
* Simulations cannot predict real events.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-ESS3-3 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-ESS3-3 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS3-3%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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