

HS-ESS3-4 Earth and Human Activity

California Science Test—Item Content Specifications

**HS-ESS3-4 Earth and Human Activity**

Students who demonstrate understanding can:

Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

[Clarification Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).]

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 |
| --- | --- | --- |
| Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific knowledge, principles and theories.  Design or refine a solution to a complex real-world problem based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. | ESS3.C: Human Impacts on Earth Systems  1. Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation.  ETS1.B: Developing Possible Solutions  1. When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (*secondary to HS-ESS3-4*) | Stability and Change Feedback (negative or positive) can stabilize or destabilize a system.  Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. |

## 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.

6E.2 Ability to evaluate and/or refine solutions to design problems

### 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.

6E.2.1 Ability to compare or critique competing design solutions based on design criteria

6E.2.2 Ability to evaluate and/or refine (optimize) design solutions based on scientific knowledge or evidence

6E.2.3 Ability to optimize performance of a design by prioritizing criteria and considering trade-offs to test, revise, and retest

### Disciplinary Core Idea Assessment Targets

#### ESS3.C.6

* Identify an Earth system (e.g., forest, wetland, stream, etc.) affected by human activity (e.g., introduction of pollution/toxic chemicals, reduction of biomass, urban development, and mining) and describe how a certain human is affecting the system
* Apply relevant scientific knowledge of environmental issues to solutions
* Describe how technological solutions may be stabilizing or destabilizing the natural system
* Identify real-world technological solutions that reduce human impacts on a natural system

#### ETS1.B.10

* Describe and quantify (when appropriate) constraints for solutions to the problem (e.g., cost, safety, reliability, aesthetics, social, and cultural constraints)
* Describe tradeoffs of the solution
* Evaluate how the proposed refinement will improve the problem and increase benefits and/or decrease costs/risks to people and the environment
* Evaluate proposed refinements for their effect on the overall stability of a natural system
* Evaluate proposed refinements for cost, safety, aesthetics, and reliability, as well as cultural and environmental impacts

### 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 several potential technological solutions to reducing pollution from a human activity:

* Identifies the best design from among multiple designs based on a prioritized list of criteria (e.g., maximize pollutant in wastewater, cost, aesthetics, etc.) (6E.2.1, ESS3.C.6, and CCC7)

Task provides several potential technological solutions to improving resource availability (e.g., crop yield) in a given area and in light of provided ecological or geological constraints:

* Identifies the best design from among multiple designs based on prioritization of criteria (e.g., maximum crop yield, minimal land use, cost, etc.) (6E.2.1, ESS3.C.6, ETS1.B.10, and CCC7)
* Provides justification for the selection (6E.2.1, ESS3.C.6, ETS1.B.10, and CCC7)

Task presents students with a technological solution to reducing amount of negative output (e.g., waste from packaging) from a human activity (e.g., shipping or transportation):

* Identifies tradeoffs that would have been necessary in a given design (6E.2.2, ESS3.C.6, ETS1.B.10, and CCC7)

Task provides information about a newly designed technology to sequester carbon dioxide in the ocean:

* Describes possible unanticipated effects of a given design, existing product, or process (6E.2.3, ESS3.C.6, ETS1.B.10, 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.

* The effectiveness of strategies for resource management (wastewater treatment processes, public land management, crop yield increases via genetic modification, aquatic food chain stabilization by reducing overfishing)
* The benefits and tradeoffs of using alternative fuels to replace traditional gasoline-powered automobiles
* The costs and benefits of recycling and proposed methods to refine the process to better reduce the impacts of humans on natural systems
* The impact that transitioning from coal-burning power plants to hydroelectric power generation has on stream flow and aquatic organisms while reducing emissions, including heavy metals and carbon dioxide

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Well-designed technological designs do not have unanticipated negative effects.
* Solutions can always eliminate human impact.
* All constraints equally influence solutions.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-ESS3-4 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-ESS3-4 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS3-4%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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