

HS-ETS1-3 Engineering Design

California Science Test—Item Content Specifications

**HS-ETS1-3 Engineering Design**

Students who demonstrate understanding can:

Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
| --- | --- | --- |
| Constructing Explanations and Designing SolutionsConstructing 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 ideas, principles and theories.Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. | ETS1.B: Developing Possible Solutions1. 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.
 | Connections to Engineering, Technology, and Applications of ScienceInfluence of Science, Engineering, and Technology on Society and the Natural WorldNew 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 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.2.2 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, making tradeoffs, testing, revising, and re-testing

### Disciplinary Core Idea Assessment Targets

#### ETS1.B.10

* Identify three or more realistic criteria and two or more constraints such as cost, safety, and reliability as factors in determining an acceptable solution to a complex real-world problem
* Analyze and describe the strengths and weaknesses of the alternative proposed solution based on the prioritized criteria and constraints, including social, cultural, and environmental impacts
* Provide an evidence-based decision of which solution is optimal, based on prioritized criteria, analysis of strengths and weaknesses of each solution, and barriers to be overcome
* Identify any components of the complex real-world problem that may remain even as alternative solution is implemented

### Crosscutting Concept Assessment Target(s)

Not applicable.

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides descriptions of two or more alternative solutions to a complex real-world problem:

* Selects the best alternative solution from among multiple solutions based on their strengths and weaknesses (6E.2.2 and ETS1.B.10)
* Provides justification for the selection based on scientific principles and/or evidence (6E.2.2 and ETS1.B.10)

Task provides a description of a solution to a complex real-world problem:

* Identifies the scientific ideas, principles, or evidence that support the effectiveness of the proposed alternative solution (6E.2.3 and ETS1.B.10)
* Identifies possible unanticipated effects of the provided solution (6E.2.3 and ETS1.B.10)
* Evaluates the solution and identifies how the proposed solution can be improved based on prioritized criteria, analysis of strengths and weaknesses of each improvement, and barriers to be overcome (6E.2.3 and ETS1.B.10)
* Identifies relevant constraints and social, cultural, and environmental impacts of the proposed solution (6E.2.3 and ETS1.B.10)

## California Environmental Principles and Concepts

* 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.

* Solutions to minimizing pollution of air or water
* Resource conservation (e.g., protecting the horseshoe crab from overharvesting)
* Responses and prevention of environmental accidents
* Bioengineering solutions (e.g., using plants or algae as possible fuel sources)
* Design of hazard-resilient buildings or structures

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Cost is always the main factor to consider in a design solution for a real-world problem.
* There is an ideal solution for each problem.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-ETS1-3 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-ETS1-3 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ETS1-3%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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