

HS-ETS1-2 Engineering Design

California Science Test—Item Content Specifications

**HS-ETS1-2 Engineering Design**

Students who demonstrate understanding can:

Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

| 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.Design a solution to a complex real-world problem based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. | ETS1.C: Optimizing the Design Solution1. Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed.
 | Not applicable |

## 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.1 Ability to solve design problems

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.1.2 Ability to generate multiple solutions for a design problem that meet design criteria and constraints

6E.1.4 Ability to apply relevant scientific knowledge and/or evidence in designing solutions

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

### Disciplinary Core Idea Assessment Targets

#### ETS1.C.5

* Restate the original problem into a finite set of two or more sub-problems (potentially as in a diagram or a flow chart)
* Identify relevant constraints and criteria that apply to designing an engineering solution to a global problem
* Provide reasoning for the approach that served as the basis for breaking down criteria (see contexts section below)
* Describe tradeoffs between solving only a limited number of the total set of problem pieces
* Identify several potential solutions to two or more of the smaller problem pieces and describe the relevant scientific ideas that govern their functioning
* Describe a sequence by which problem pieces should be solved and support that sequence with scientific reasoning
* Combine design solutions from two or more pieces (simultaneously or in some described sequence) to reach an engineering goal

### 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 a description of a global problem, broken down into several pieces to facilitate design or analysis:

* Proposes several unique solutions (6E.1.2 and ETS1.C.5)

Task provides both a description of a global problem and information from outside resources about how several existing engineering designs attempt to solve one piece of the larger problem:

* Provides a description of the relevant scientific ideas or principles that underlie the performance of each small solution (6E.1.4 and ETS1.C.5)
* Generates an accurate description of how the several solutions work together to solve the larger problem (6E.1.4 and ETS1.C.5)

Task provides both a description of a global problem and information from outside resources about several proposed design solutions. Task also provides a description of wants and needs of relevant stakeholders:

* Matches the described solutions to a provided list of broken-down criteria/constraints (6E.2.1 and ETS1.C.5)
* Uses scientific reasoning to describe how several proposed solutions may work in sequence or in tandem to meet more problem criteria than any one solution could achieve alone (6E.2.1 and ETS1.C.5)

Task provides a description of a global problem that has been broken down into several pieces for design or analysis. Task also provides a description of wants and needs of relevant stakeholders:

* Selects or generates relevant tradeoffs that particular stakeholders would be willing to adopt in designing a solution (6E.2.1 and ETS1.C.5)

Task provides a description of a global problem that has been broken down into several pieces to facilitate design or analysis. Task also provides information regarding how an existing engineering solution that meets just some of the criteria was chosen in favor of several alternatives:

* Explains the design of the provided solution in terms of which criteria and/or constraints were prioritized by relevant stakeholders (6E.2.1 and ETS1.C.5)

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* Breaking down a multidisciplinary problem into its many domain ideas
* Breaking down a problem into goals that can be ranked in terms of importance or need for immediate action
* Breaking down a problem into its chronological sequence of causes and effects
* Breaking down a problem by considering individual, local, or statewide efforts
* Identifying the parts of a global problem as criteria or constraints relevant to the engineering design

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Global challenges can only be solved by global action.
* Global problems should be solved with an all-or-nothing approach.
* Decisions about what criteria to prioritize should not consider human wants or needs.
* Future trends that may affect the status of present criteria or constraints on a design problem cannot be predicted.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-ETS1-2 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-ETS1-2 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ETS1-2%20Evidence%20Statements%20June%202015%20asterisks.pdf)

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>

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