

HS-ETS1-4 Engineering Design

California Science Test—Item Content Specifications

**HS-ETS1-4 Engineering Design**

Students who demonstrate understanding can:

Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
| --- | --- | --- |
| Using Mathematics and Computational ThinkingMathematical 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.Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems. | ETS1.B: Developing Possible Solutions1. Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.
 | Systems and System ModelsModels (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions — including energy, matter, and information flows — within and between systems at different scales. |

## 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.

5.2 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.

5.2.1 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

#### ETS1.B.11

* Describe a complex real-world problem with criteria and constraints from a given computer simulation
* Identify the system being modeled by a computer simulation
* Identify the variables that can be changed in a computer simulation
* Identify the scientific principles used in a model of a complex real-world problem
* Select logical and realistic inputs for a computer simulation of a complex real-world problem
* Use a model to simulate the effects of different solutions, tradeoffs, criteria, and constraints
* Compare results from a model to expected results
* Identify possible consequences of a solution to a complex real-world problem
* Identify the limitations of a particular model

### Crosscutting Concept Assessment Target(s)

CCC4 Use models (e.g., physical, mathematical, computer models) to simulate systems and interactions — including energy, matter, and information flows — within and between systems at different scales

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides a possible solution to a complex real-world problem and data generated from a computer simulation of the problem:

* Uses the data generated from the simulation to support or refute the design solution (5.2.1, ETS1.B.11, and CCC4)

Task provides a computer simulation of a complex real-world problem:

* Makes predictions for certain combinations of variable settings in the simulation related to a scientific phenomenon (5.2.2, ETS1.B.11, and CCC4)

Task provides data from one or more computer simulations of a complex real-world problem:

* Identifies patterns based on the simulation(s) (5.2.3, ETS1.B.11, and CCC4)

Task provides data from a computer simulation of a complex real-world problem:

* Uses statistical tools to analyze the data (5.2.4, ETS1.B.11, and CCC4)
* Identifies limitations of the simulation using statistical tools (5.2.4, ETS1.B.11, and CCC4)

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* Impacts of solutions to minimize pollution (of air or water), conserve water, contain or clean up oil spills, save endangered species, or prevent habitat loss due to development
* Bioengineering scenarios, including artificial limbs
* Approaches to sustainable design (e.g., “green” buildings, structures that are earthquake-resilient, and solutions that reduce tsunami damage or debris flow)
* Management of renewable resources for energy production (e.g., wind farm design)

## Common Misconceptions

None listed at this time.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-ETS1-4 Evidence Statement

[https://www.nextgenscience.org/sites/default/files/HS-ETS1-4\_Evidence Statements Jan 2015.pdf](https://www.nextgenscience.org/sites/default/files/HS-ETS1-4_Evidence%20Statements%20Jan%202015.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>

Posted by the California Department of Education, March 2021 (updated February 2024)