# Engineering Design—High School

# Alternate Item Content Specifications

**Prepared for the California Department of Education by Educational Testing Service**



**Presented August 1, 2020**

 

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## HS-ETS1-1 Engineering Design

| California Science Connector | Focal Knowledge, Skills, and Abilities | Essential Understanding |
| --- | --- | --- |
| Define a real-world problem or challenge (e.g., need for clean water, food, and energy sources) and identify solutions. | 1. Ability to define a real-world problem or challenge.
2. Ability to evaluate specified qualitative and quantitative criteria and constraints in the design of a solution for a defined problem.
 | Identify criteria for acceptable solutions to a problem. |

### CA NGSS Performance Expectation

Students who demonstrate understanding can:

**Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.**

### Mastery Statements

Students will be able to:

* Identify one criterion for an effective solution to a problem
* Identify an example of a real-world problem or challenge
* Identify which criterion or constraint is the most important in the design of a solution to a real-world problem

### Possible Phenomena or Contexts

*Note that the list in this section is not exhaustive or prescriptive.*

**Possible contexts include the following:**

* Ways to reduce garbage production
* Air pollution from smog or wildfires that affects people’s ability to spend time outside
* Ways to improve the habitat for birds and common city wildlife
* Enhancing mobility for people with disabilities
* Ways to reduce energy use or use cleaner energy sources

### Additional Assessment Boundaries

* None listed at this time

### Additional References

California Science Test Item Specification for HS-ETS1-1

<https://www.cde.ca.gov/ta/tg/ca/documents/itemspecs-hs-ets1-1.docx>

Environmental Principles and Concepts <http://californiaeei.org/abouteei/epc/>

The *2016 Science Framework for California Public Schools Kindergarten through Grade Twelve* <https://www.cde.ca.gov/ci/sc/cf/cascienceframework2016.asp>

Appendix 1: Progression of the Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts in Kindergarten through Grade Twelve

<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>

## HS-ETS1-2 Engineering Design

| California Science Connector | Focal Knowledge, Skills, and Abilities | Essential Understanding |
| --- | --- | --- |
| Break down a real-world problem into smaller problems that can be approached systematically to solve. | 1. Ability to identify a real-world problem.
2. Ability to identify solutions to the problem
 | Identify how to solve one part of a larger problem. |

### CA NGSS Performance Expectation

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.**

### Mastery Statements

Students will be able to:

* Identify a solution for part of a problem that has several components
* Identify an example of a real-world problem
* Identify one solution to a real-world problem
* Identify the smaller problems that make up a real-world problem
* Identify more than one solution to a real-world problem

### Possible Phenomena or Contexts

*Note that the list in this section is not exhaustive or prescriptive.*

**Possible contexts include the following:**

* Ways to reduce garbage production
* Air pollution from smog or wildfires that affects people’s ability to spend time outside
* Ways to improve the habitat for birds and common city wildlife
* Enhancing mobility for people with disabilities
* Ways to reduce energy use or use cleaner energy sources

### Additional Assessment Boundaries

* None listed at this time

### Additional References

California Science Test Item Specification for HS-ETS1-2

<https://www.cde.ca.gov/ta/tg/ca/documents/itemspecs-hs-ets1-2.docx>

Environmental Principles and Concepts <http://californiaeei.org/abouteei/epc/>

The *2016 Science Framework for California Public Schools Kindergarten through Grade Twelve* <https://www.cde.ca.gov/ci/sc/cf/cascienceframework2016.asp>

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## HS-ETS1-3 Engineering Design

| California Science Connector | Focal Knowledge, Skills, and Abilities | Essential Understanding |
| --- | --- | --- |
| Describe the strengths and weaknesses of a solution to a real-world problem with respect to specific criteria and trade-offs, as well as possible social and cultural acceptability and environmental impacts. | 1. Ability to describe the strengths and weaknesses of a solution to a real-world problem with respect to specific criteria and trade-offs.
2. Ability to describe the strengths and weaknesses of a solution to a real-world problem with respect to possible social and cultural acceptability and environmental impacts.
 | With guidance, identify a possible barrier to the solution of a real-world problem. |

### CA NGSS Performance Expectation

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.**

### Mastery Statements

Students will be able to:

* Identify one factor that would have to be overcome for a solution to a real-world problem to work
* Identify a strength or weakness of a solution to a real-world problem
* Identify how a solution to a real-world problem does or does not meet a specific criterion
* Identify a strength or weakness of a solution to a real-world problem based on its effect on society or the environment
* Identify two ways a solution to a real-world problem does or does not meet specified criteria
* Identify a strength and a weakness of a solution to a real-world problem based on its effect on society or the environment

### Environmental Principles and Concepts

Principle 5—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 or prescriptive.*

**Possible contexts include the following:**

* Ways to reduce garbage production
* Air pollution from smog or wildfires that affects people’s ability to spend time outside
* Ways to improve the habitat for birds and common city wildlife
* Enhancing mobility for people with disabilities
* Ways to reduce energy use or use cleaner energy sources

### Additional Assessment Boundaries

* None listed at this time

### Additional References

California Science Test Item Specification for HS-ETS1-3

<https://www.cde.ca.gov/ta/tg/ca/documents/itemspecs-hs-ets1-3.docx>

Environmental Principles and Concepts <http://californiaeei.org/abouteei/epc/>

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## HS-ETS1-4 Engineering Design

| California Science Connector | Focal Knowledge, Skills, and Abilities | Essential Understanding |
| --- | --- | --- |
| Use computer simulations to evaluate the impact of proposed solutions to a real-world problem to see which one is most efficient or economical.  | 1. Ability to use computer simulations to evaluate the impact of proposed solutions to a real-world problem to see which one is most efficient or economical.
2. Ability to use computer simulations to evaluate solutions to see which one is most efficient or economical.
 | Compare different possible solutions to a real-world problem.  |

### CA NGSS Performance Expectation

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.**

### Mastery Statements

Students will be able to:

* Identify the best solution to a real-world problem
* Use the results of a computer simulation to identify which solution to a real-world problem is most efficient or economical
* Use the results of a computer simulation on the impact of a solution to a real-world problem to identify which solution is most efficient or economical
* Use the results of a computer simulation to identify which solution to a real-world problem is most efficient or economical and which is least efficient or economical
* Use the results of a computer simulation to identify which solution impact for a real‑world problem is most efficient or economical and which is least efficient or economical

### Possible Phenomena or Contexts

*Note that the list in this section is not exhaustive or prescriptive.*

**Possible contexts include the following:**

* Ways to reduce garbage production
* Air pollution from smog or wildfires that affects people’s ability to spend time outside
* Ways to improve the habitat for birds and common city wildlife
* Enhancing mobility for people with disabilities
* Ways to reduce energy use or use cleaner energy sources

### Additional Assessment Boundaries

* None listed at this time

### Additional References

California Science Test Item Specification for HS-ETS1-4

<https://www.cde.ca.gov/ta/tg/ca/documents/itemspecs-hs-ets1-4.docx>

Environmental Principles and Concepts <http://californiaeei.org/abouteei/epc/>

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*Posted by the California Department of Education, August 2020*