

3-5-ETS1-2 Engineering Design

California Science Test—Item Content Specifications

# 3-5-ETS1-2 Engineering Design

Students who demonstrate understanding can:

Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
| --- | --- | --- |
| Constructing Explanations and Designing Solutions  Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.  Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. | ETS1.B: Developing Possible Solutions   1. Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. 2. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. | Influence of Science, Engineering, and Technology on Society and the Natural World  Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. |

## 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.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

### Disciplinary Core Idea Assessment Targets

#### ETS1.B.2

* Translate research on the wants or needs of stakeholders into criteria for success for a potential design solution
* Describe the role of criteria and constraints in helping to select among multiple potential design solutions
* Identify instances in which stakeholders make tradeoffs among a broad list of wants and needs in order to keep a design solution within relevant constraints

#### ETS1.B.3

* Describe the underlying simple physical principles that govern the functioning of a potential design solution
* Describe the functioning of a potential design solution in terms of the ability of the design to meet relevant criteria
* Describe the functioning of a potential design solution in terms of how well it stays within the constraints of the design problem
* Propose novel ways for communicating ideas regarding the function of a potential design solution to relevant stakeholders with particular wants or needs

### 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 information regarding an engineering design problem, the desires of relevant stakeholders, and the translation of their wants/needs into a set of meaningful criteria and constraints on potential solutions:

* Generates (or selects from a broad list) at least two unique potential solutions that fit within the constraints of the stakeholders while still meeting their criteria for success (6E.1.2 and ETS1.B.2)
* Selects the design from among multiple potential design solutions that best meets the criteria for success while staying within relevant constraints (6E.2.1 and ETS1.B.2)
* Generates an explanation for the selection based on prioritization of some criteria over others in light of relevant constraints (6E.2.1 and ETS1.B.2)

Task provides information about the desires of relevant stakeholders leading to an engineering design problem, the translation of their wants/needs into a set of meaningful criteria and constraints on potential solutions, and a proposed design solution:

* Identifies which wants/needs the design solution meets and which it failed to meet (6E.2.1 and ETS1.B.2)
* Generates (or selects) an explanation for why the stakeholders prioritized some criteria over others and that focuses on the role of constraints on limiting potential solutions (6E.2.1 and ETS1.B.2)
* Generates or selects a method for testing whether the functioning of the proposed solution meets the criteria for success or stays within relevant constraints (6E.2.2 and ETS1.B.3)

Task provides information regarding a simple engineering design problem and several unique potential solutions:

* Identifies scientific ideas or principles that govern the effectiveness of each potential solution (6E.2.2 and ETS1.B.3)
* Generates a viable constraint that might assist in selecting among the potential solutions provided (6E.2.2 and ETS1.B.3)

## 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.

* Capital or human resource cost
* Risk of failure and/or potential negative impacts of failure in a solution
* Availability of relevant materials or resources
* Negative impacts of a solution
* Improving the functionality of a given system
* Decreasing the risk of failure in an existing system
* Meeting the demands of relevant stakeholders

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Choices among design solutions should be made on aesthetic preference rather than on meeting the criteria/constraints of a problem.
* The wants or needs of a local community will not change over time.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

3-5-ETS1-2 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/3-5-ETS1-2 Evidence Statements June 2015 asterisks-5.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/3-5-ETS1-2%20Evidence%20Statements%20June%202015%20asterisks-5.pdf)

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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