

HS-ETS1-1 Engineering Design

California Science Test—Item Content Specifications

**HS-ETS1-1 Engineering Design**

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.

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
| --- | --- | --- |
| Asking Questions and Defining Problems  Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.  Analyze complex real-world problems by specifying criteria and constraints for successful solutions. | ETS1.A: Defining and Delimiting Engineering Problems   1. Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. 2. Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. | Connections to Engineering, Technology, and Applications of Science  Influence of Science, Engineering, and Technology on Society and the Natural World  New 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.

1E.1 Ability to ask questions about a design problem or the designed world

1E.2 Ability to define a design problem

### 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.

1E.1.2 Ability to ask questions to identify, clarify, or refine an engineering problem

1E.2.2 Ability to define a design problem to develop an object, process, or system that takes into consideration criteria and constraints based on scientific concepts

1E.2.3 Ability to define a design problem for a process or system with interacting components that takes into consideration criteria, constraints, and different scientific perspectives

### Disciplinary Core Idea Assessment Targets

#### ETS1.A.6

* Identify relevant physical principles that govern the functioning of a design solution
* Define engineering problem statements based on background research on the nature of the problem and on pre-existing solutions
* Develop criteria for evaluating a design solution based on the problem statement and constraints on viability

#### ETS1.A.7

* Identify global challenges that share features across various societies and geographies
* Describe factors that impact how a global challenge manifests with local variations in local communities
* Refine an engineering problem statement in light of social wants and needs that vary from global to local scales

### 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 challenge that faces a local community:

* Selects or generates questions that could help determine criteria or constraints for design solutions (1E.1.2, ETS1.A.6, and ETS1.A.7)

Task provides a description of a global challenge that faces a local community. It also provides a description of some of the wants and needs of that community:

* Selects or develops an appropriate engineering problem statement that considers how local wants and needs dictate criteria and constraints (1E.2.2, ETS1.A.6, and ETS1.A.7)

Task provides a flawed problem definition for a global challenge that faces a local community. It also provides a description of some of the wants and needs of that community:

* Identifies aspects of the flawed problem definition that is inconsiderate of local wants and needs (1E.2.2, ETS1.A.6, and ETS1.A.7)
* Generates a refined problem definition that is considerate of local wants and needs (1E.2.2, ETS1.A.6, and ETS1.A.7)

Task provides a description of a global challenge that is manifesting in a particular fashion in a local community:

* Selects, from a list of possible problem definitions, the definition that best considers both physical and socially defined constraints or criteria on potential design solutions (1E.2.2, ETS1.A.6, and ETS1.A.7)

Task provides a problem definition for a global challenge that faces a local community. It also provides a description of some of the wants and needs of various global and local stakeholders:

* Generates different variations on the problem definition that highlight the unique concerns of different stakeholder groups (e.g., an environmental group and a manufacturer of a product) (1E.2.3 and ETS1.A.7)

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

Engineering tasks that consider:

* Cost of development
* Features of the local geography
* Differential features of local climate
* Local and global trends in human behavior
* Solutions to reduce the impact of fossil fuels and their derivatives (e.g., using solar-powered lanterns instead of kerosene lanterns)

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Design solutions should not consider human needs or behaviors.
* Global challenges are unsolvable or can only be solved by global action.
* Future trends that may affect the status of present criteria or constraints cannot be predicted.
* Design solutions should not consider multiple sources.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-ETS1-1 Evidence Statement <https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ETS1-1%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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