

3-5-ETS1-3 Engineering Design

California Science Test—Item Content Specifications

# 3-5-ETS1-3 Engineering Design

Students who demonstrate understanding can:

Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
| --- | --- | --- |
| Planning and Carrying Out Investigations  Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.  Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. | ETS1.B: Developing Possible Solutions  Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.  ETS1.C: Optimizing the Design Solution   1. Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. | 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.

3.1 Ability to clarify the goal of the investigation and identify the evidence needed to address the purpose of the investigation

3.2 Ability to develop, evaluate, and refine a plan for the investigation

3.3 Ability to collect the data for the investigation

### 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.

3.1.1 Ability to describe the purpose of the investigation or formulate a question that can be investigated

3.1.2 Ability to identify relevant independent and dependent variables and to consider possible confounding variables or effects

3.2.1 Ability to decide how to measure and observe relevant variables, including considering the level of accuracy and precision required, and the kinds of instrumentation and techniques best suited to making such measurements to reduce both random and systematic error

3.2.2 Ability to describe detailed experimental procedure, including how the data will be collected, the number of trials, the experimental set up, and the equipment and tools required

3.3.1 Ability to use appropriate tools for accurate and precise measurements

### Disciplinary Core Idea Assessment Targets

#### ETS1.B.4

* Describe the reasoning for why an aspect of an engineering solution could be improved that considers relevant criteria and constraints
* Identify data that can serve as evidence for the satisfactory or unsatisfactory functioning of some aspect of an engineering solution
* Describe what tools are appropriate for collecting needed data

#### ETS1.C.2

* Break down an engineering solution into multiple pieces that interact but can be tested and/or amended independently
* Identify appropriate dependent and independent variables in light of the aspects of a solution that are the subject of the investigation
* Describe the controls needed to draw relevant conclusions about the functioning of a design solution
* Describe the implications of the results of an investigation on avenues for improving aspects of an engineering solution

### 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 both a description (which may take the form of a picture-based or simulation-based model) of an engineered prototype as well as a list of available tools:

* Selects an investigation regarding the functioning of the prototype that could be reasonably accomplished using the provided list of tools (3.1.1 and ETS1.B.4)

Task provides a description of an investigation that sought to investigate the functioning of an engineered prototype:

* Identifies factors that would need to be controlled to get a satisfactory measure of the functioning of the prototype (3.1.2 and ETS1.B.4)
* Identifies aspects of the investigation that do not appropriately consider factors that, while not related to the investigation goal, may affect the outcome of the investigation (3.1.2 and ETS1.B.4)

Task provides a description (which may take the form of a picture-based or simulation-based model) of an engineered prototype with particular focus on some aspect of the prototype that can be refined:

* Selects tools from a list that would be most appropriate for investigating the functioning of a particular aspect of a prototype (3.2.1 and ETS1.C.2)
* Generates or selects experimental procedures appropriate to draw conclusions about the functioning of the prototype (3.2.2 and ETS1.B.4)
* Identifies what is to be recorded and what are to be treated as the dependent and independent variables (3.2.2 and ETS1.B.4)

Task provides a simulation of an engineered prototype with particular focus on some aspect of the prototype that can be refined. The interface provides several tools that can be used to investigate the status of different aspects of prototype functioning:

* Provides data collected with available tools (3.3.1 and ETS1.B.4)
* Draws an appropriate conclusion for collected data regarding whether an aspect of the prototype functions satisfactorily (3.3.1 and ETS1.B.4)

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* Temperature measurements to identify losses of energy to the environment
* Noise to identify appropriate or inappropriate interactions between moving parts (e.g., a squeaky door needs improved functioning of hinges)
* Weight measurements to identify losses of matter to the environment
* Observations from a scientific demonstration
* Optimization of a device design test
* Failure analysis of a structure

## Common Misconceptions

Note that the list in this section is not exhaustive.

* A failed model provides no value to the design process.
* Failure points in a design solution cannot be fixed via ad hoc amendments.
* Failure points found via simulations of prototype functioning do not represent failure points of the actual prototype.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

3-5-ETS1-3 Evidence Statement <https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/3-5-ETS1-3%20Evidence%20Statements%20June%202015%20asterisks-6.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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