

4-PS4-3 Waves and Their Applications in Technologies for Information Transfer

California Science Test—Item Content Specifications

# 4-PS4-3 Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

Generate and compare multiple solutions that use patterns to transfer information.

[Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1’s and 0’s representing black and white to send information about a picture, and using Morse code to send text.]

| 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 solution. | PS4.C: Information Technologies and Instrumentation  2. Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa.  ETS1.C: Optimizing the Design Solution  2. Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. *(secondary to 4-PS4-3)* | Patterns  Similarities and differences in patterns can be used to sort and classify designed products.  Connections to Engineering, Technology, and Applications of Science  Interdependence of Science, Engineering, and Technology  Knowledge of relevant scientific concepts and research findings is important in engineering. |

## 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.1.4 Ability to apply relevant scientific knowledge and/or evidence in designing solutions

6E.2.1 Ability to compare or critique competing design solutions based on design criteria

### Disciplinary Core Idea Assessment Targets

#### PS4.C.2

* Recognize different types of patterns that encode information
* Recognize different systems of digitized information
* Understand that information can be encoded to a digital system, transmitted, and decoded
* Describe that digitized information can be transmitted over long distances without significant degradation
* Identify devices that can convert and transmit information

#### ETS1.C.2

* Understand that design solutions are evaluated by testing how well they meet certain criteria (e.g., transmittal of information) and constraints (e.g., distance, amount and cost of materials, and safety)

### Crosscutting Concept Assessment Target(s)

CCC1 Use similarities and differences in patterns to sort and classify designed products

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides a description of a problem to be solved by using a digital system to transmit information, the design criteria, and multiple design solutions:

* Selects the design solution(s) that best meet(s) the criteria (e.g., transfer information in a digital format) (6E.1.2, PS4.C.2, and CCC1)

Task provides a description of a problem to be solved by using a digital system to transmit information and annotated representations of design solutions:

* Selects the annotated representation that highlights the science concepts underlying the performance of the design solutions (e.g., the conversion of sound into a digital format and vice-versa) (6E.1.4, PS4.C.2, and CCC1)

Task provides a description of a problem to be solved by using a digital system to transmit information, multiple design solutions, and prioritized criteria or constraints:

* Selects the best design solution based on the prioritized criteria or constraints (6E.2.1, PS4.C.2, and CCC1)
* Identifies the advantages and disadvantages of the design solutions based on the criteria and constraints (6E.2.1, PS4.C.2, and CCC1)
* Selects the best design and provides justification for the selection based on prioritization of criteria or constraints (6E.2.1, PS4.C.2, and CCC1)

Task provides both a description of a problem to be solved by using a digital system to transmit information and a design solution:

* Identifies prioritized criteria and/or constraints that resulted in the selection of one design over alternative designs (6E.2.1, PS4.C.2, and CCC1)

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* Evaluating accuracy of information transfer using sound waves versus digital signals
* Comparing messages sent by sound waves versus digital signals
* Coding messages with sound waves versus light signals
* Communicating over large distances using light signals
* Using visuals or sounds to represent digital signals

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Radio signals are sound waves.
* Signals can be transmitted instantaneously and without loss.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

[4-PS4-3 Evidence Statement](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/4-PS4-3%20Evidence%20Statements%20June%202015%20asterisks.pdf) <https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/4-PS4-3%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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