

HS-PS4-2 Waves and their Applications in Technologies for Information Transfer

California Science Test—Item Content Specifications

# HS-PS4-2 Waves and their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

Evaluate questions about the advantages of using a digital transmission and storage of information.

[Clarification Statement: Examples of advantages could include that digital information is stable because it can be stored reliably in computer memory, transferred easily, and copied and shared rapidly. Disadvantages could include issues of easy deletion, security, and theft.]

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
| --- | --- | --- |
| Asking Questions and Defining Problems  Asking questions and defining problems in grades 9–12 builds from grades K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.  Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set or the suitability of a design. | PS4.A: Wave Properties  8. Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. | Stability and Change  Systems can be designed for greater or lesser stability.  Connections to Engineering, Technology, and Applications of Science  Influence of Engineering, Technology, and Science on Society and the Natural World  Modern civilization depends on major technological systems.  Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. |

## 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.

1.2 Ability to ask and evaluate scientific questions arising from examining models, explanations, and arguments to specify relationships between variables

1.3 Ability to ask and evaluate questions that can be investigated

### 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.

1.2.3 Ability to ask and/or evaluate questions that challenge the premise(s) of an argument, or provide interpretation of a data set

1.3.3 Ability to evaluate a question to determine if it is empirically testable and relevant

### Disciplinary Core Idea Assessment Targets

#### PS4.A.8

* Describe different mechanisms by which analog information can be transformed into a digital form so that it can be reliably stored and sent over long distances as a series of wave pulses
* Describe the advantages of various forms of digital storage and transmission, such as reliable storage without degradation over time, ease of transfer, and ability to copy and share rapidly
* Describe the disadvantages of various forms of digital storage and transmission, such as ease of deletion, ability to be stolen through making a copy, and broad access
* Describe the stability and importance of systems that use digital storage and transmission
* Discuss the relevance of digital storage and transmission to real-life practices

### Crosscutting Concept Assessment Target(s)

CCC7 Identify that systems can be designed for greater or lesser stability

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides an argument about the advantages or disadvantages of using digital transmission and/or digital storage of information, as well as a list of questions that challenge the argument:

* Selects the appropriate question(s) that challenge the argument (i.e., a question with an answer that can be empirically determined) (1.2.3, PS4.A.8, and CCC7)

Task provides a data set and an interpretation of the data set related to the advantages or disadvantages of using digital transmission and/or digital storage of information, as well as a list of questions that challenge the interpretation:

* Selects the appropriate question(s) that challenge the interpretation of the data set (i.e., a question with an answer that can be empirically determined) (1.2.3, PS4.A.8, and CCC7)

Task provides information regarding various features of a digital storage or transmission system, as well as a list of questions regarding advantages/disadvantages of the system:

* Identifies whether each question is or is not empirically testable considering the information provided (1.3.2, PS4.A.8, and CCC7)
* Identifies the question that is most relevant to the provided information about the storage or transmission system (1.3.2, PS4.A.8, and CCC7)
* Provides valid reasoning for why a question is not empirically testable or not relevant to the information provided (1.3.2, PS4.A.8, and CCC7)

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* Information storage on optical disks (e.g., CDs, DVDs, and Blu-ray discs)
* Information storage using flash memory (e.g., USB drives, solid state drives, modern RAM)
* Comparison of the quality of digital images and their film counterparts, including resolution and storage requirements
* Communication systems and devices that utilize digital transmission
* Devices that convert digitized signals to analog signals and vice versa

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Digital formats cannot encode complex information because it depends on binary coding.
* Digital storage of information is bad.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-PS4-2 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-PS4-2 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS4-2%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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