

MS-PS4-1 Waves and Their Applications in Technologies for Information Transfer

California Science Test—Item Content Specifications

# MS-PS4-1 Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.

[Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.] [*Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.*]

Continue to the next page for the Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts.

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
| --- | --- | --- |
| Using Mathematics and Computational ThinkingMathematical and computational thinking at the 6–8 level builds on K–5 and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments.Use mathematical representations to describe and/or support scientific conclusions and design solutions.Connections to Nature of ScienceScientific Knowledge is Based on Empirical EvidenceScience knowledge is based upon logical and conceptual connections between evidence and explanations. | PS4.A: Wave Properties1. A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.
 | PatternsGraphs and charts can be used to identify patterns in data. |

## 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.

5.2 Ability to conduct mathematical and/or computational analyses

### 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.

5.2.1 Ability to use the results of computational models (e.g., simulations) to identify patterns in natural and/or design worlds

5.2.2 Ability to use the results of computational models to identify the mathematical and/or computational representations that support a scientific explanation or a design solution

### Disciplinary Core Idea Assessment Targets

#### PS4.A.4

* Identify the properties of a simple mathematical wave model of a phenomenon
* Mathematically represent the properties of a simple wave (e.g., wavelength, frequency, amplitude)
* Relate the properties of a mathematical model of a wave to their corresponding properties in physical phenomena
* Relate the properties of a wave to the energy of the wave
* Use a mathematical model to predict how a change in one property of a wave will change the amount of energy present or transmitted

### Crosscutting Concept Assessment Target(s)

CCC1 Use graphs and charts to identify patterns in data

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides data about a repeating physical phenomenon that can be represented as a wave:

* Identifies the mathematical relationship between amplitude and energy (energy is proportional to the square of the amplitude) (5.2.1, PS4.A.4, and CCC1)
* Identifies the relationships between frequency, wavelength, wave speed, and energy transmitted in a given time (5.2.1, PS4.A.4, and CCC1)
* Identifies the properties of the mathematical wave model that correspond to the properties of the physical phenomenon (5.2.1, PS4.A.4, and CCC1)

Task provides a mathematical model or a description about a repeating physical phenomenon that can be represented as a wave:

* Uses the model to identify how the energy of the wave changes based on a change in another property (5.2.2, PS4.A.4, and CCC1)
* Uses the model to make predictions about the physical phenomenon (5.2.2, PS4.A.4, and CCC1)

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* Effect of noise-canceling headphones on sound wave energy
* Relationship of frequency to pitch and amplitude to volume in sound waves
* Relationship of amplitude to energy in water waves (i.e., doubling wave height quadruples wave energy)
* Increasing wave energy without changing wavelength in mechanical waves (e.g., waves on a string)

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Period, frequency, and wavelength are interchangeable.
* Amplitude affects wavelength and/or frequency.
* Changing the frequency of a sound wave changes its volume.
* Changing the volume of a sound wave changes its frequency.
* The energy of a wave is unrelated to its amplitude.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

MS-PS4-1 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/MS-PS4-1 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/MS-PS4-1%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>

Posted by the California Department of Education, March 2021 (updated February 2024)