

MS-PS4-2 Waves and Their Applications in Technologies for Information Transfer

California Science Test—Item Content Specifications

# MS-PS4-2 Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

[Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.] [*Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical 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 |
| --- | --- | --- |
| Developing and Using Models  Modeling in 6–8 builds on K–5 and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.  Develop and use a model to describe phenomena. | PS4.A: Wave Properties  5. A sound wave needs a medium through which it is transmitted.  PS4.B: Electromagnetic Radiation  4. When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object’s material and the frequency (color) of the light.  5. The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends.  A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media.  However, because light can travel through space, it cannot be a matter wave, like sound or water waves. | Structure and Function  Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. |

## 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.

2.1 Ability to develop models

2.3 Ability to evaluate and revise models

### 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.

2.1.1 Ability to determine components of a scientific event, system, or design solution

2.1.2 Ability to determine the relationships among multiple components of a scientific event, system, or design solution

2.1.4 Ability to represent mechanisms, relationships, and connections to illustrate, explain, or predict a scientific event

2.3.2 Ability to revise models in light of empirical evidence to improve their explanatory and predictive power

### Disciplinary Core Idea Assessment Targets

#### PS4.A.5

* Identify the type of wave, such as matter waves (sound, water, etc.) and light waves
* Describe how the medium through which a sound wave travels affects properties like speed, frequency, amplitude, or wavelength
* Identify wave properties such as amplitude and frequency, which for light waves are connected to brightness and color, respectively

#### PS4.B.4

* Describe the three ways in which waves can interact with material (reflection, absorption, and transmission) and that the interaction occurring depends on the object’s material and the frequency of the wave

#### PS4.B.5

* Describe the movement of light and its interaction with various transparent media as straight lines which bend at material transitions
* Describe why certain materials are good for certain functions, such as lenses and mirrors, sound absorbers, colored light filters, and sound barriers next to highways

#### PS4.B.6

* Describe properties of light (brightness, color, and the frequency-dependent bending of light at a surface between different media) using a model that governs wave behavior

#### PS4.B.7

* Determine the position of the source of a wave using a model
* Differentiate between light and matter waves, since light does not require a physical material for propagation, but matter waves do

### Crosscutting Concept Assessment Target(s)

CCC6 Identify that structures can be designed to serve particular functions by taking into account properties of different materials, and how the materials can be shaped and used

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides a description of a light or sound wave that experiences a change in properties after experiencing a change in medium:

* Generates (or selects) a wave model which best reflects the phenomenon that has occurred (2.1.1, PS4.A.5, PS4.B.6, and CCC6)

Task provides an incomplete model of a wave passing from an original medium to a second medium and then back that only shows the first transition (from *m*1 to *m*2) but not the second (from *m*2 back to *m*1):

* Completes the second part of the model (from *m*2 back to *m*1) (2.1.1, PS4.B.6, and CCC6)

Task provides a model of a wave passing through an unknown medium which results in a change to some wave properties (e.g., wavelength, frequency, amplitude, and color, etc.):

* Identifies properties of the medium (reflectivity, density, color, etc.) based on the change to properties in the wave (2.1.3, PS4.B.5, PS4.B.6, and CCC6)
* Identifies the unknown medium from a list of alternatives based on the change to properties in the wave (2.1.3, PS4.B.5, PS4.B.6, and CCC6)

Task provides a model of a travelling wave transitioning from one unknown medium to another. The task then provides new information regarding relative properties of the media in question (reflectivity, density, color, etc.):

* Selects (or generates) a new model that better describes the transition between media considering the newly provided information (2.3.2, PS4.B.4, and CCC6)
* Provides sound reasoning for why the revised model is a better descriptor of the phenomena in question (2.3.2, PS4.B.4, and CCC6)

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* Visible mechanical waves created in strings, bungee cords, Slinkys, and other malleable materials
* Invisible sound waves created by a tuning fork or vocal cords
* Electromagnetic waves in the visible light spectrum created by a lightbulb, a laser, the Sun, or some other source

## Common Misconceptions

Note that the list in this section is not exhaustive.

* The brightness of light is dependent on the color (frequency) as well as amplitude.
* The speed of light is always the same, regardless of the medium through which light travels.
* A sound wave is the movement of air particles.
* A physical wave can move matter permanently to a new location along the wave’s direction of propagation.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

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