Unless otherwise specified, "descriptions" referenced in the evidence statements could include but are not limited to written, oral, pictorial, and kinesthetic descriptions.

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

Students who demonstrate understanding can:

MS-PS4-2. **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.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

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.

Disciplinary Core Ideas

PS4.A: Wave Properties

- A sound wave needs a medium through which it is transmitted.

PS4.B: Electromagnetic Radiation

- 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.
- 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.

Crosscutting Concepts

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.

Observable features of the student performance by the end of the course:

1	Components of the model	
	a	Students develop a model to make sense of a given phenomenon. In the model, students identify the relevant components, including:
		i. Type of wave.
		1. Matter waves (e.g., sound or water waves) and their amplitudes and frequencies.
		2. Light, including brightness (amplitude) and color (frequency).
		ii. Various materials through which the waves are reflected, absorbed, or transmitted.
		iii. Relevant characteristics of the wave after it has interacted with a material (e.g., frequency, amplitude, wavelength).
		iv. Position of the source of the wave.
2	Relationships	
	a	In the model, students identify and describe* the relationships between components, including:
		i. Waves interact with materials by being:
		1. Reflected.
		2. Absorbed.
		3. Transmitted.
		ii. Light travels in straight lines, but the path of light is bent at the interface between materials when it travels from one material to another.
		iii. Light does not require a material for propagation (e.g., space), but matter waves do require a material for propagation.
3	Connections	
	a	Students use their model to make sense of given phenomena involving reflection, absorption, or transmission properties of different materials for light and matter waves.

	b	Students use their model about phenomena involving light and/or matter waves to describe* the differences between how light and matter waves interact with different materials.
	c	Students use the model to describe* why materials with certain properties are well-suited for particular functions (e.g., lenses and mirrors, sound absorbers in concert halls, colored light filters, sound barriers next to highways).