

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

Students who demonstrate understanding can:

- 4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.** [Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.] [Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.]

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 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- Develop a model using an analogy, example, or abstract representation to describe a scientific principle.

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence

- Science findings are based on recognizing patterns.

Disciplinary Core Ideas

PS4.A: Wave Properties

- Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. (Note: This grade band endpoint was moved from K–2.)
- Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks).

Crosscutting Concepts

Patterns

- Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena.

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

1	Components of the model
a	Students develop a model (e.g., diagrams, analogies, examples, abstract representations, physical models) to make sense of a phenomenon that involves wave behavior. In the model, students identify the relevant components, including: <ol style="list-style-type: none"> Waves. Wave amplitude. Wavelength. Motion of objects.
2	Relationships
a	Students identify and describe the relevant relationships between components of the model, including: <ol style="list-style-type: none"> Waves can be described in terms of patterns of repeating amplitude and wavelength (e.g., in a water wave there is a repeating pattern of water being higher and then lower than the baseline level of the water). Waves can cause an object to move. The motion of objects varies with the amplitude and wavelength of the wave carrying it.
3	Connections
a	Students use the model to describe: <ol style="list-style-type: none"> The patterns in the relationships between a wave passing, the net motion of the wave, and the motion of an object caused by the wave as it passes. How waves may be initiated (e.g., by disturbing surface water or shaking a rope or spring). The repeating pattern produced as a wave is propagated.
b	Students use the model to describe that waves of the same type can vary in terms of amplitude and wavelength and describe how this might affect the motion, caused by a wave, of an object.

	c	Students identify similarities and differences in patterns underlying waves and use these patterns to describe simple relationships involving wave amplitude, wavelength, and the motion of an object (e.g., when the amplitude increases, the object moves more).
--	---	--