

Dumpster Optics

Next Generation Science Standards (NGSS) Alignment

(Note: PS refers to Physical Science)

Grade 1: 1-PS4 Waves and their Applications in Technologies for Information Transfer

Disciplinary Core Ideas

PS4.B Electromagnetic Radiation

- Objects can be seen if light is available to illuminate them or if they give off their own light. (performance expectation 1-PS4-2)
- Some materials allow light to pass through them, others allow only some light through, and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.) (performance expectation 1-PS4-4)

PS4.C Information Technologies and Instrumentation

- People also use a variety of devices to communicate (send and receive information) over long distances. (performance expectation 1-PS4-4)

Performance Expectations

Students who demonstrate understanding can:

- 1-PS4-2 Make observations to construct an evidence-based account that objects can be seen only when illuminated (clarification: Illumination could be from an external source or the object giving off its own light.)
- 1-PS4-3 Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light. (Clarification: examples of materials could include transparent, opaque and reflective.)
- 1-PS4-4 Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance. Note this performance expectation integrates traditional science content with engineering through a practice of disciplinary core ideas.

Science and Engineering Practices

Planning and Carrying out Investigations

- Plan and conduct investigations collaboratively to produce data to serve as the basis for evidence to answer a question. (performance expectation 1-PS4-3)

Constructing Explanations and Designing Solutions

- Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (performance expectation 1-PS4-4)
- Use tools and materials provided to design a device that solves a specific problem. (performance expectation 1-PS4-4)

Crosscutting Concepts

Cause and Effect

- Simple tests can be designed to gather evidence to support or refute student ideas about causes. (performance expectations 1-PS4-1, 1-PS4-2, 1-PS4-3)

Influence of Engineering, technology and Science on Society and the Natural World

- People depend on various technologies in their lives; human life would be very different without technology. (performance expectation 1-PS4-4)

Grade 4: 4-PS4 Waves and their Applications in Technologies for Information Transfer

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. (performance expectation 4-PS4-1)
- Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (performance expectation 4-PS4-1)

PS4.B Electromagnetic Radiation

- An object can be seen when light reflected from its surface enters the eyes. (performance expectation 4-PS4-2)

Performance Expectations

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.)
- 4-PS4-2 Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. (Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision or how the retina works.)

Science and Engineering Practices

Developing and Using Models

- Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (performance expectation 4-PS4-1)
- Develop a model to describe phenomena. (performance expectation 4-PS4-2)

Crosscutting Concepts

Patterns

- Similarities and differences in patterns can be used to sort and classify natural phenomena. (performance expectation 4-PS4-1)

Cause and Effect

- Cause and effect relationships are routinely identified. (performance expectation 4-PS4-2)

Middle School: MS-PS4 Waves and their Applications in Technologies for Information Transfer

Disciplinary Core Ideas

PS4.A Wave Properties

- A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (performance expectation MS-PS4-1)

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. (performance expectation MS-PS4-2)
- 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. (performance expectation MS-PS4-2)
- A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (performance expectation MS-PS4-2)
- However, because light can travel through space, it cannot be a matter wave, light sound or water waves. (performance expectation MS-PS4-2)

PS4.C Information Technologies and Instrumentation

- Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (performance expectation MS-PS4-3)

Performance Expectations

Students who demonstrate understanding can:

- MS-PS4-1 Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy of the wave.
- MS-PS4-2 Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. (Clarification: Emphasis is on both light and mechanical waves).
- MS-PS4-3 Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. (Clarification: Emphasis is on basic understanding that waves can be used for communication purposes. Examples could include using fiber optics cable to transmit light pulses...)

Science and Engineering Practices

Developing and Using Models

- Develop and use a model to describe phenomena. (performance expectation MS-PS4-2)

Using Mathematics and Computational Thinking

- Use mathematical representations to describe and/or support scientific conclusions and design solutions. (performance expectation MS-PS4-1)

Obtaining, Evaluating, and Communicating Information

- Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings. (performance expectation MS-PS4-3)

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. (performance expectation MS-PS4-2)
- Structures can be designed to serve particular functions. (performance expectation MS-PS4-3)