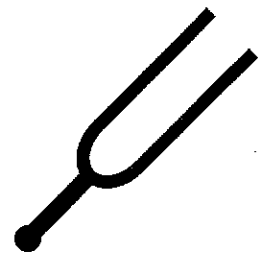


PS4: Waves and Their Applications in Technologies for Information Transfer

PS4.A: Wave Properties



1st Grade	4th Grade	8th Grade	Physical Science	Chemistry	Physics
<p>Sound can make matter vibrate, and vibrating matter can make sound.</p>	<p>Waves, which are regular patterns of motion, can be made in water by disturbing the surface.</p> <p>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.</p> <p>Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks).</p>	<p>A simple wave has a repeating pattern with a specific wave-length, frequency, and amplitude.</p> <p>A sound wave needs a medium through which it is transmitted.</p>	<p>The fact that atoms are conserved, together with knowledge.</p>	<p>The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing.</p> <p>Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of the peaks and troughs of the waves), but they emerge unaffected by each other.</p> <p>Boundary: The discussion at this grade level is quantitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.</p>	<p>The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing.</p> <p>Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses.</p> <p>Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other.</p> <p>Boundary: The discussion at this grade level is quantitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.</p>

PS4: Waves and Their Applications in Technologies for Information Transfer

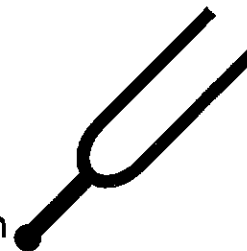
PS4.B: Electromagnetic Radiation



1st Grade	4th Grade	8th Grade	Physical Science	Chemistry	Physics
<p>Objects can be seen if light is available to illuminate them or if they give off their own light.</p> <p>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.</p> <p>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.)</p>	<p>An object can be seen when light reflected from its surface enters the eyes.</p>	<p>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.</p> <p>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.</p> <p>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.</p>	<p>When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat).</p> <p>Shorter wavelength electromagnetic radiation (ultraviolet, Xrays, gamma rays) can ionize atoms and cause damage to living cells.</p> <p>Photoelectric materials emit electrons when they absorb light of high-enough frequency.</p>	<p>Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons.</p> <p>The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features.</p>	<p>Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons.</p> <p>The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features.</p> <p>When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat).</p> <p>Shorter wavelength electromagnetic radiation (ultraviolet, Xrays, gamma rays) can ionize atoms and cause damage to living cells.</p> <p>Photoelectric materials emit electrons when they absorb light of high-enough frequency.</p>

PS4: Waves and Their Applications in Technologies for Information Transfer

PS4.C: Information Technologies and Instrumentation



1st Grade	4th Grade	8th Grade	Physics
<p>People also use a variety of devices to communicate (send and receive information) over long distances.</p>	<p>Digitized information can be transmitted over long distances without significant degradation.</p> <p>High-tech devices, such as computers or cell phones, can receive and decode information - convert it from digitized form to voice - and vice versa.</p>	<p>Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.</p>	<p>Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them.</p>