

Strand 8.2: Energy is stored and transferred in physical systems	Objects can store and transfer energy within systems. Energy can be transferred between objects, which involves changes in the object's energy. There is a direct relationship between an object's energy, mass, and velocity. Energy can travel in waves and may be harnessed to transmit information.	
Standard: 8.2.4 (MS-PS4-1.)	Use computational thinking to describe a simple <u>model</u> for waves that shows the <u>pattern</u> of wave amplitude being related to wave energy. Emphasize describing waves with both quantitative and qualitative thinking. Examples could include using graphs, charts, computer simulations, or physical models to demonstrate amplitude and energy correlation.	
SEP/CCC	Using Mathematics and Computational Thinking Use mathematical representations to describe and/or support scientific conclusions and design solutions.	Systems and system models Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems Patterns Graphs and charts can be used to identify patterns in data.
DCI	PS4.A: Wave Properties <ul style="list-style-type: none"> • A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. 	
Student Friendly Objective	I can draw a model that shows the patterns of how a wave's amplitude is related to the energy of the wave.	
Anchor Phenomena	The amplitude of a wave is related to the wave energy.	
Vertical Learning Progression	Previous Science Content (Discussed in K-7 Standards) <ul style="list-style-type: none"> • Sound can make matter vibrate, and vibrating matter can make sound. • Waves are regular patterns of motion. • Waves of the same type can differ in amplitude and wavelength. 	Future Science Content (Discussed in 9-12 Standards) <ul style="list-style-type: none"> • The wavelength and frequency of a wave are related to one another by the speed of the wave, which depends on the type of wave and the medium through which it is passing. • Both an electromagnetic wave model and a photon model explain features of electromagnetic radiation. • Waves can be used to transmit information and energy. • Calculating energy of a wave • Units of amplitude • Transverse and Longitudinal waves • Compressional waves
What students will be doing this year:	Representation <ol style="list-style-type: none"> Students identify the characteristics of a simple mathematical wave model of a phenomenon, including: <ol style="list-style-type: none"> Waves represent repeating quantities. Frequency, as the number of times the pattern repeats in a given amount of time (e.g., beats per second). Amplitude, as the maximum extent of the repeating quantity from equilibrium (e.g., height or depth of a water wave from average sea level). Wavelength, as a certain distance in which the quantity repeats its value (e.g., 	

the distance between the tops of a series of water waves).

Mathematical modeling

- a. Students apply the simple mathematical wave model to a physical system or phenomenon to identify how the wave model characteristics correspond with physical observations (e.g., frequency corresponds to sound pitch, amplitude corresponds to sound volume).

Analysis

- a. Given data about a repeating physical phenomenon that can be represented as a wave, and amounts of energy present or transmitted, students use their simple mathematical wave models to identify patterns, including:
 - i. That the energy of the wave is proportional to the square of the amplitude (e.g., if the height of a water wave is doubled, each wave will have four times the energy).
 - ii. That the amount of energy transferred by waves in a given time is proportional to frequency (e.g., if twice as many water waves hit the shore each minute, then twice as much energy will be transferred to the shore).
- b. Students predict the change in the energy of the wave if any one of the parameters of the wave is changed.