Module 3: Modern Atomic Theory, Electron Structure, and Periodicity

Topic 1 Content: Light as a Wave Presentation Notes

Light as a Wave

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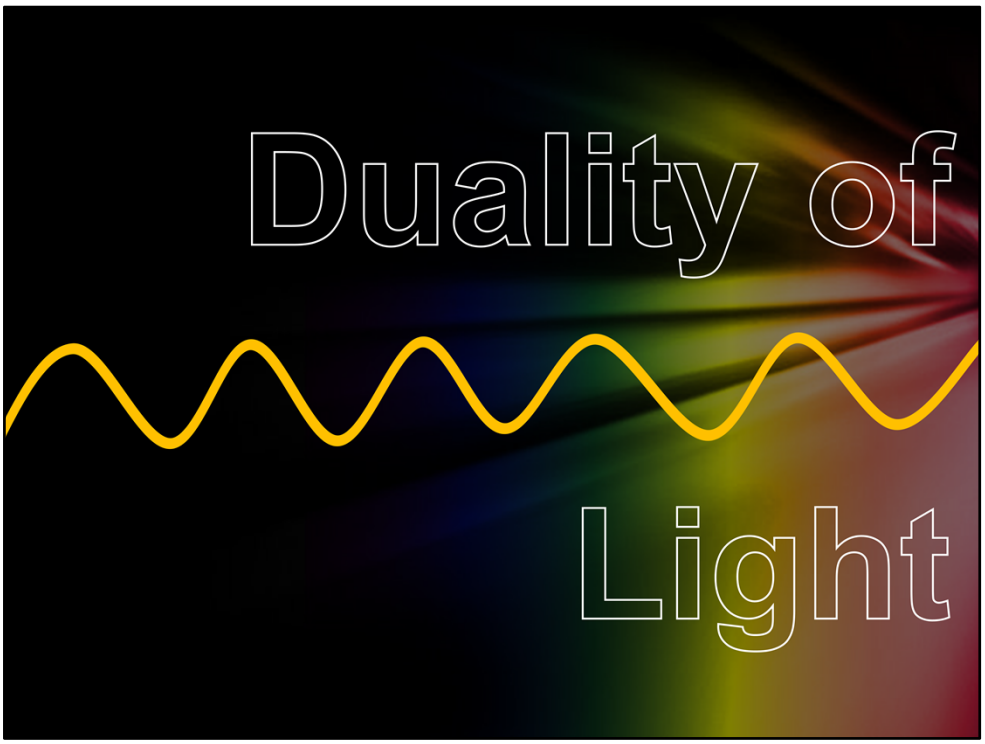

For a long time, scientists believed that light was made of small, fast-moving particles. Later, the scientific community accepted that light moves as waves. Today, physicists understand that light is composed of waves and particles, named photons. This is known as the nature or “duality” of light. The discovery of the relationship between light and energy was an important one because it helped scientists discover more and more about atoms, the behavior of electrons, and the different elements. Studying the properties of light as it travels through the electromagnetic spectrum can help scientists determine the composition of objects.

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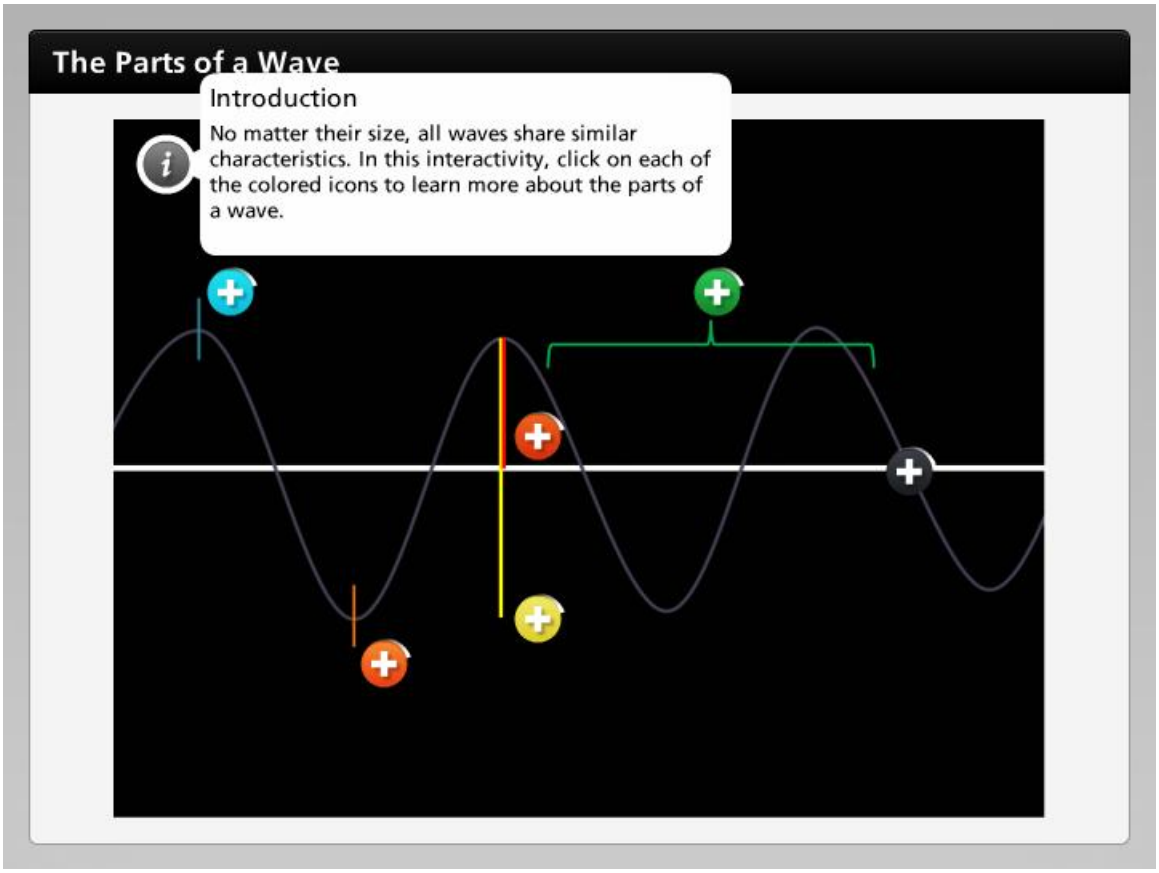
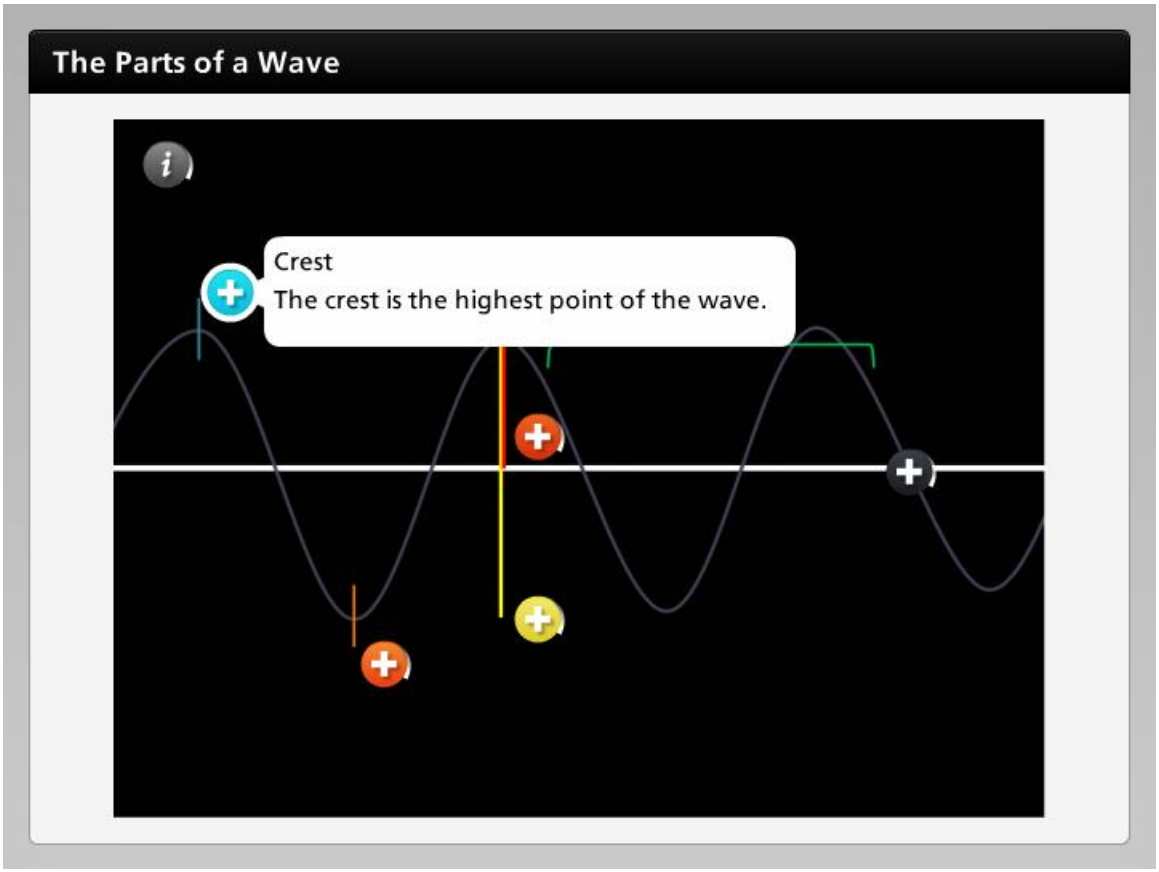
Introduction



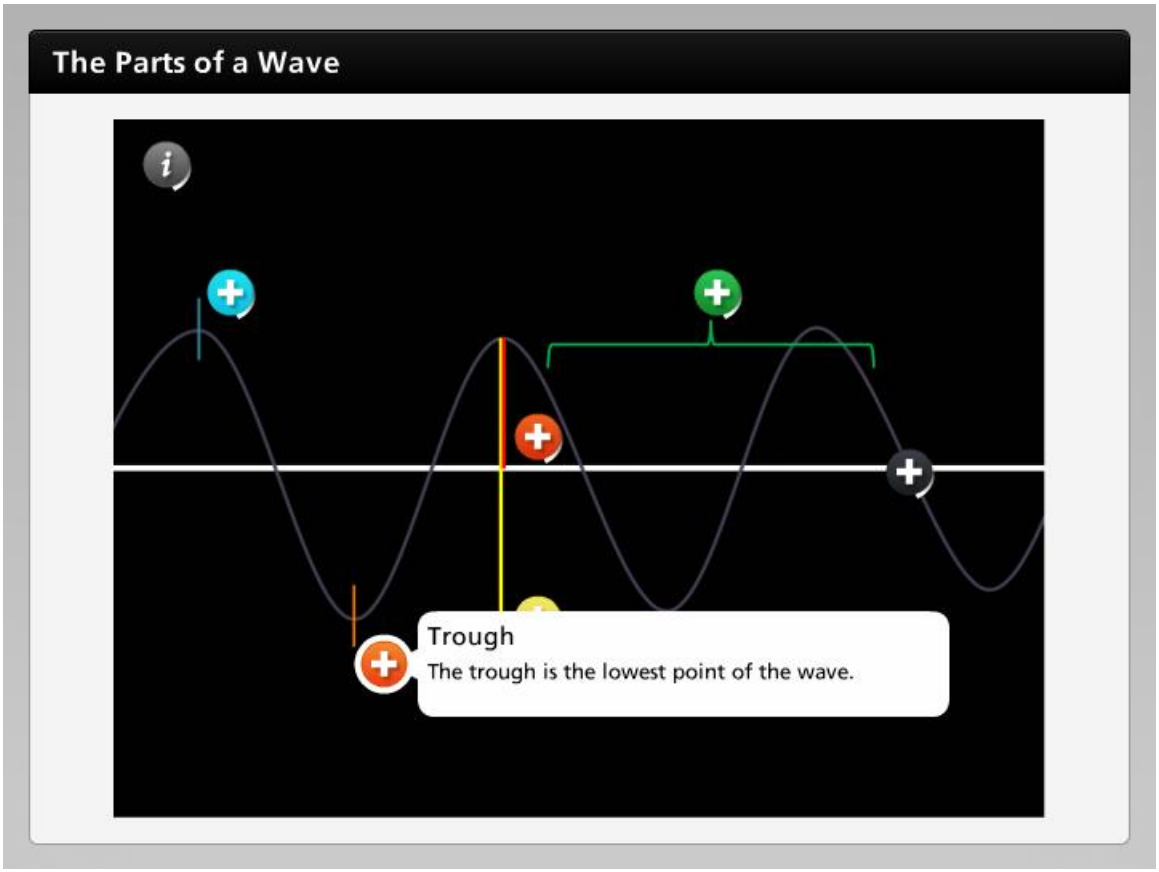
No matter their size, all waves share similar characteristics. In this interactivity, click on each of the colored icons to learn more about the parts of a wave.

Crest



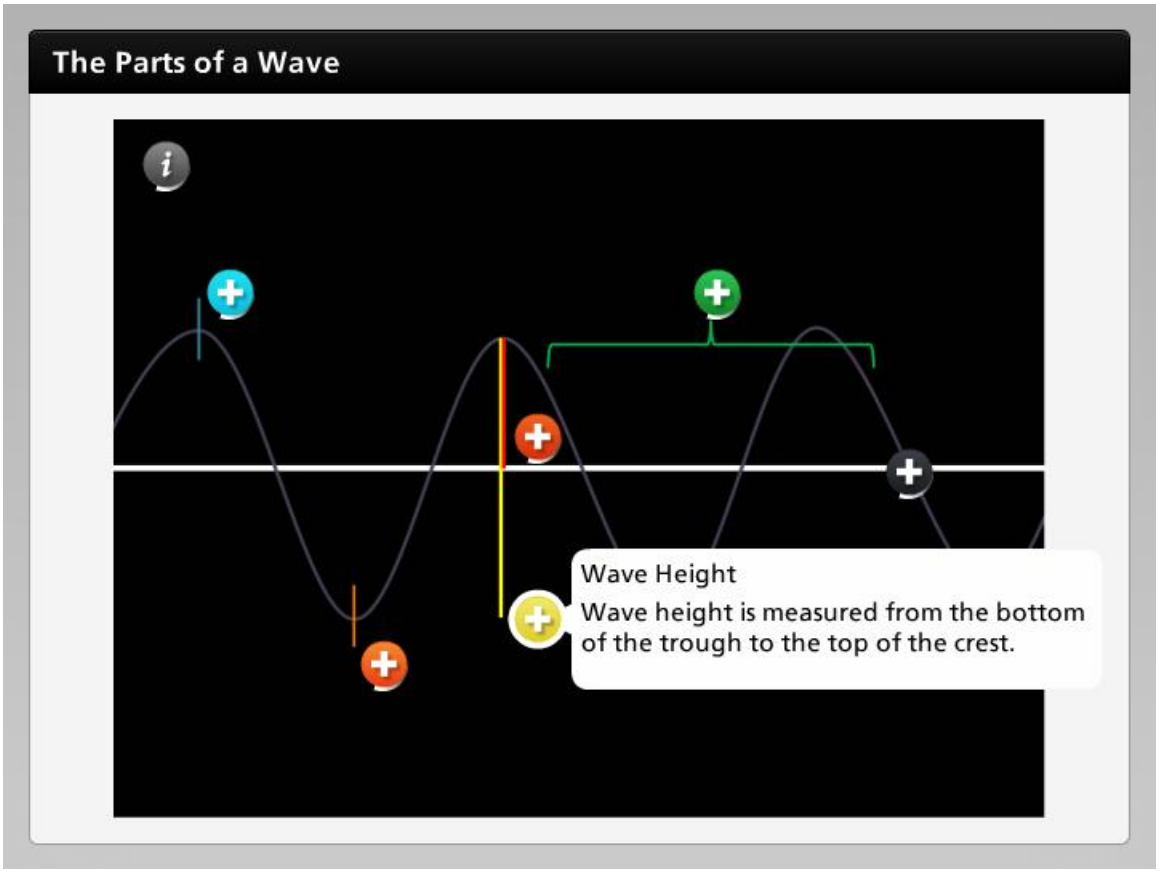
The crest is the highest point of the wave.

Trough



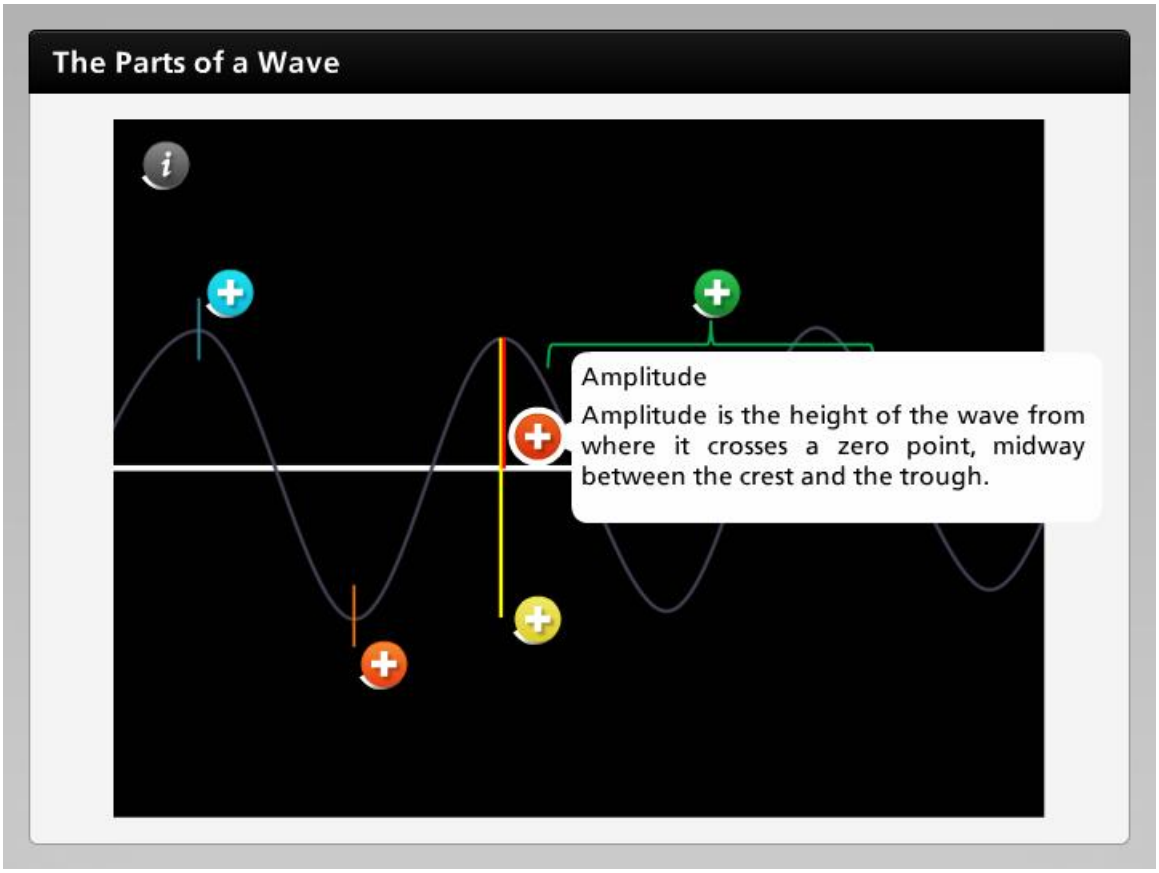
The trough is the lowest point of the wave.

Wave Height



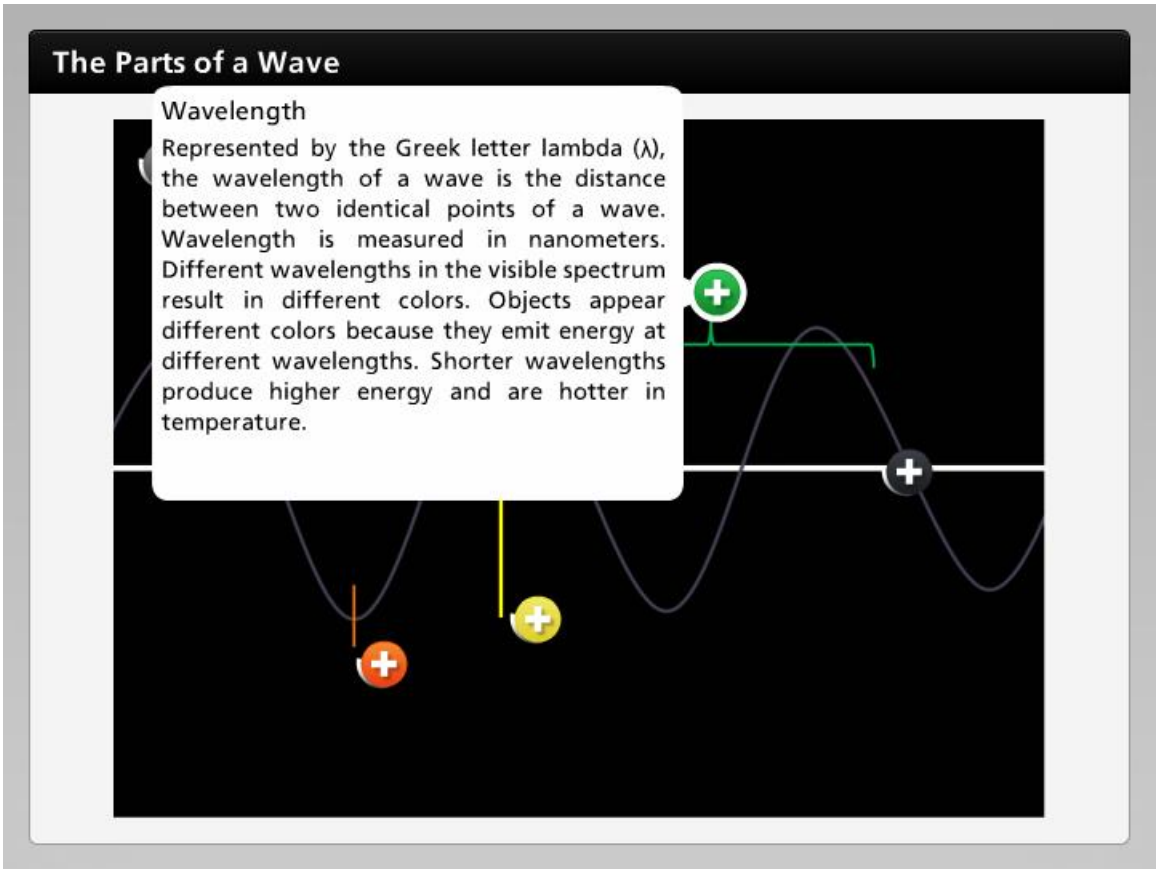
Wave height is measured from the bottom of the trough to the top of the crest.

Amplitude



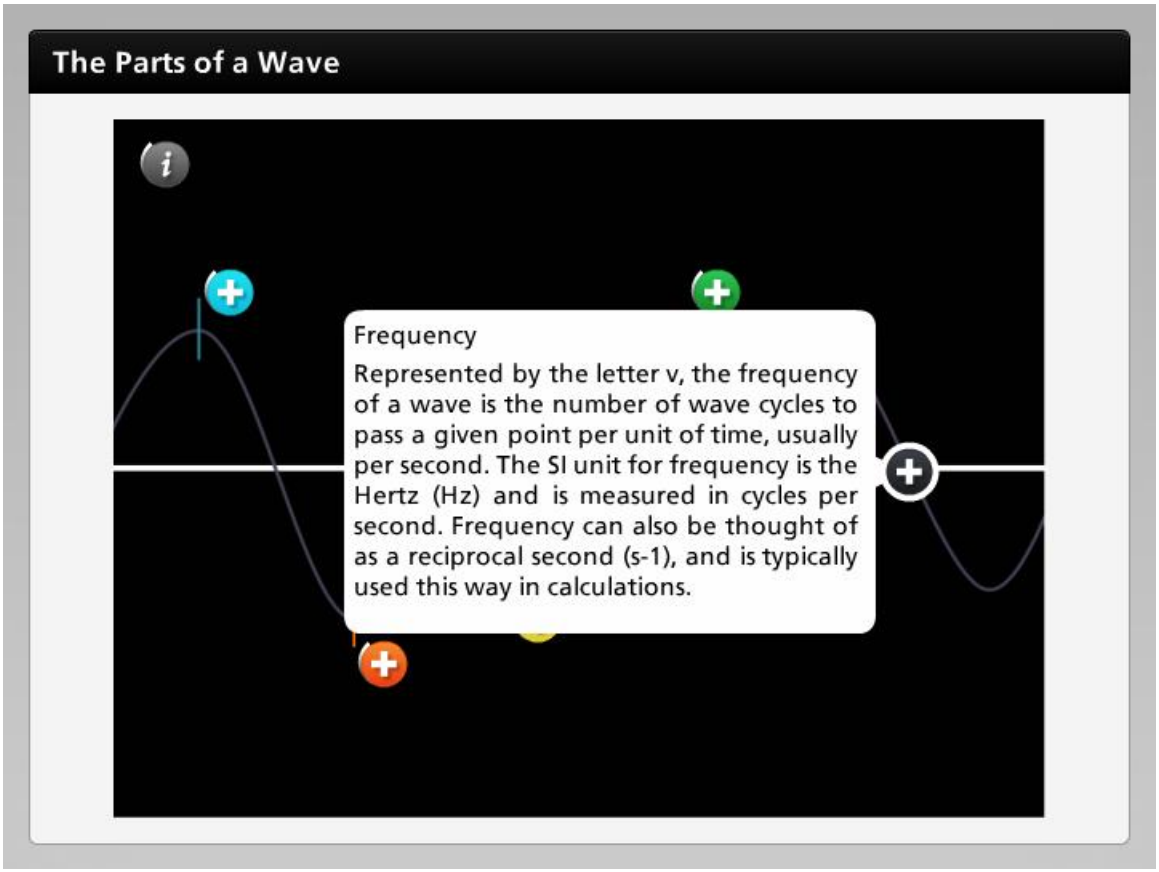
Amplitude is the height of the wave from where it crosses a zero point, midway between the crest and the trough.

Wavelength



Represented by the Greek letter lambda (λ), the wavelength of a wave is the distance between two identical points of a wave. Wavelength is measured in nanometers. Different wavelengths in the visible spectrum result in different colors. Objects appear different colors because they emit energy at different wavelengths. Shorter wavelengths produce higher energy and are hotter in temperature.

Frequency



Represented by the letter v, the frequency of a wave is the number of wave cycles to pass a given point per unit of time, usually per second. The SI unit for frequency is the Hertz (Hz) and is measured in cycles per second. Frequency can also be thought of as a reciprocal second (s-1), and is typically used this way in calculations.

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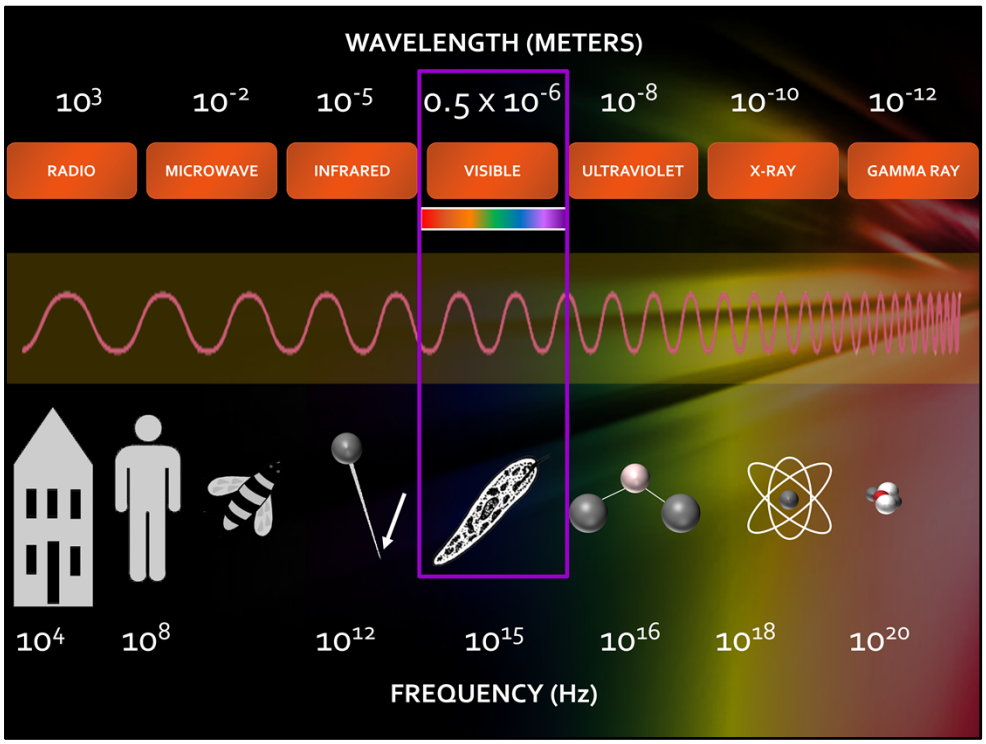

The electromagnetic spectrum starts with very long radio waves. These waves have a wavelength of 102 meters and a frequency of 300 kHz. The electromagnetic spectrum includes radio waves, microwaves, infrared, visible light, ultraviolet, x-rays, and gamma rays. According to the wave model, visible light consists of a small portion of the electromagnetic spectrum.

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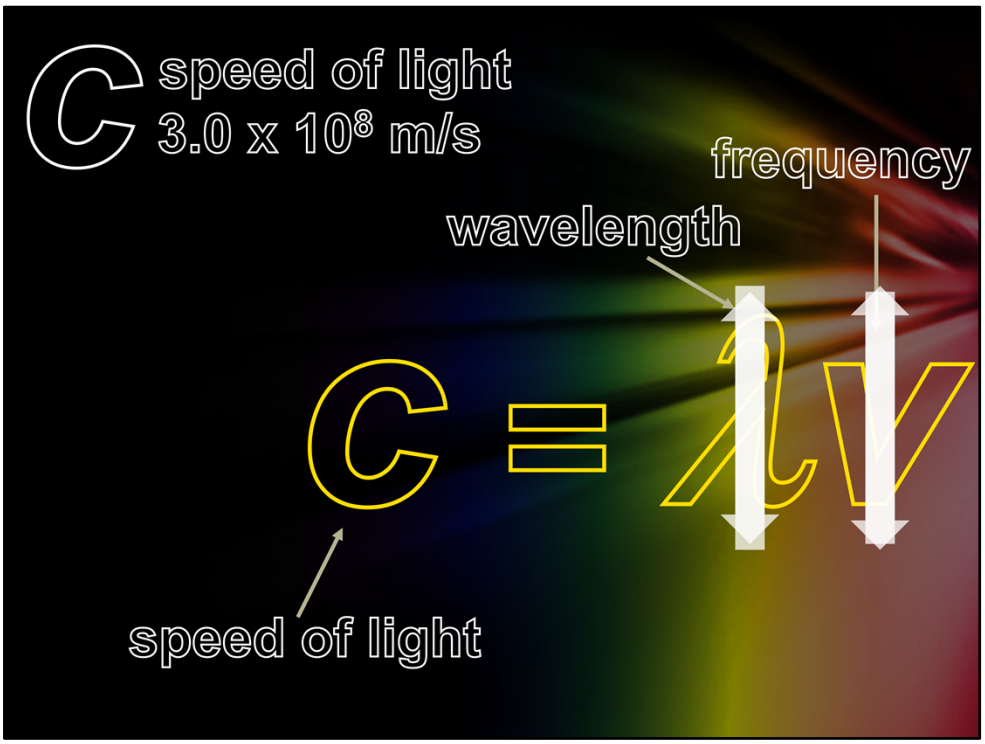
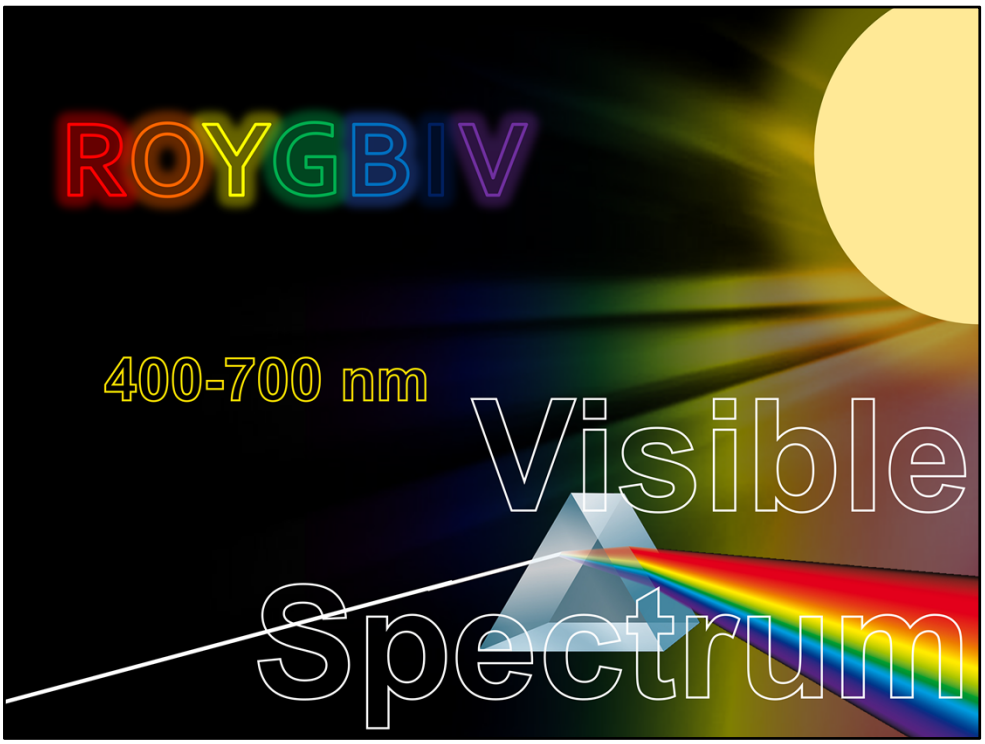


The product of frequency and wavelength equals a constant, the speed of light which is represented as *c*. The formula for the speed of light in terms of frequency and wavelength is $c = \lambda v$, or the speed of light equals wavelength times frequency. *C* is a constant that measures 3.0 x10^8 m/s. Wavelength is inversely proportional to the frequency. Shorter wavelengths have higher frequency and longer wavelengths have lower frequency. All electromagnetic radiation travels at a rate of 3.0 x 10^8 m/s, or the speed of light, in a vacuum. The speed of light is slightly slower as electromagnetic radiation travels through different media like air, water, glass, et cetera.



Sunlight is the most common light source on Earth. It covers the visible wavelengths in a continuous spectrum. These colors include red, orange, yellow, green, blue, indigo, and violet, as indicated by the acronym ROYGBIV. Visible light has a frequency of 400 nanometers to 700 nanometers. Sir Isaac Newton discovered that white light could be broken down into the spectrum using a prism, yet mankind had been seeing it for thousands of years as a rainbow. Sunlight is refracted by rain drops acting as a prism. The longer wavelengths are bent the least by any prism.