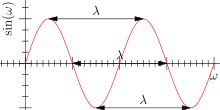
Wavelength:---

In [physics](http://en.wikipedia.org/wiki/Physics), the **wavelength** of a [sinusoidal wave](http://en.wikipedia.org/wiki/Sinusoidal_wave) is the spatial period of the wave—the distance over which the wave's shape repeats.[[1]](http://en.wikipedia.org/wiki/Wavelength#cite_note-hecht-1) It is usually determined by considering the distance between consecutive corresponding points of the same [phase](http://en.wikipedia.org/wiki/Phase_%28waves%29), such as crests, troughs, or [zero crossings](http://en.wikipedia.org/wiki/Zero_crossing), and is a characteristic of both traveling waves and [standing waves](http://en.wikipedia.org/wiki/Standing_wave), as well as other spatial wave patterns.[[2]](http://en.wikipedia.org/wiki/Wavelength#cite_note-Seaway-2)[[3]](http://en.wikipedia.org/wiki/Wavelength#cite_note-3) Wavelength is commonly designated by the [Greek letter](http://en.wikipedia.org/wiki/Greek_letter) [*lambda*](http://en.wikipedia.org/wiki/Lambda) (λ). The concept can also be applied to periodic waves of non-sinusoidal shape.[[1]](http://en.wikipedia.org/wiki/Wavelength#cite_note-hecht-1)[[4]](http://en.wikipedia.org/wiki/Wavelength#cite_note-Flowers-4) The term *wavelength* is also sometimes applied to [modulated](http://en.wikipedia.org/wiki/Modulation) waves, and to the sinusoidal [envelopes](http://en.wikipedia.org/wiki/Envelope_%28mathematics%29) of modulated waves or waves formed by [interference](http://en.wikipedia.org/wiki/Interference_%28wave_propagation%29) of several sinusoids.[[5]](http://en.wikipedia.org/wiki/Wavelength#cite_note-5) The [SI](http://en.wikipedia.org/wiki/SI) unit of wavelength is the [meter](http://en.wikipedia.org/wiki/Meter).

Assuming a sinusoidal wave moving at a fixed wave speed, wavelength is inversely proportional to [frequency](http://en.wikipedia.org/wiki/Frequency) of the wave: waves with higher frequencies have shorter wavelengths, and lower frequencies have longer wavelengths.[[6]](http://en.wikipedia.org/wiki/Wavelength#cite_note-6)

Examples of wave-like phenomena are [sound waves](http://en.wikipedia.org/wiki/Sound_wave), [light](http://en.wikipedia.org/wiki/Light), and [water waves](http://en.wikipedia.org/wiki/Water_wave). A [sound](http://en.wikipedia.org/wiki/Sound) wave is a variation in air [pressure](http://en.wikipedia.org/wiki/Sound_pressure), while in [light](http://en.wikipedia.org/wiki/Light) and other [electromagnetic radiation](http://en.wikipedia.org/wiki/Electromagnetic_radiation) the strength of the [electric](http://en.wikipedia.org/wiki/Electric_field) and the [magnetic field](http://en.wikipedia.org/wiki/Magnetic_field) vary. Water waves are variations in the height of a body of water. In a crystal [lattice vibration](http://en.wikipedia.org/wiki/Lattice_vibration), atomic positions vary.

Wavelength is a measure of the distance between repetitions of a shape feature such as peaks, valleys, or zero-crossings, not a measure of how far any given particle moves. For example, in sinusoidal waves over deep water a particle near the water's surface moves in a circle of the same diameter as the wave height, unrelated to wavelength.[[7]](http://en.wikipedia.org/wiki/Wavelength#cite_note-Pinet-7)



**Modulation:---**

In [electronics](http://en.wikipedia.org/wiki/Electronics) and [telecommunications](http://en.wikipedia.org/wiki/Telecommunications), **modulation** is the process of varying one or more properties of a periodic [waveform](http://en.wikipedia.org/wiki/Waveform), called the [*carrier signal*](http://en.wikipedia.org/wiki/Carrier_wave), with a *modulating signal* which typically contains information to be transmitted.

In [telecommunications](http://en.wikipedia.org/wiki/Telecommunications), modulation is the process of conveying a message signal, for example a digital bit stream or an [analog](http://en.wikipedia.org/wiki/Analog_signal) audio signal, inside another signal that can be physically transmitted. Modulation of a sine waveform is used to transform a [baseband](http://en.wikipedia.org/wiki/Baseband) message signal into a [passband](http://en.wikipedia.org/wiki/Passband) signal.

A device that performs modulation is known as a modulator and a device that performs the inverse operation of modulation is known as a [demodulator](http://en.wikipedia.org/wiki/Demodulator) (sometimes *detector* or *demod*). A device that can do both operations is a [modem](http://en.wikipedia.org/wiki/Modem) (from "**mo**dulator–**dem**odulator").

The aim of **digital modulation** is to transfer a [digital](http://en.wikipedia.org/wiki/Digital_data) bit stream over an analog [bandpass](http://en.wikipedia.org/wiki/Bandpass) [channel](http://en.wikipedia.org/wiki/Channel_%28communications%29), for example over the [public switched telephone network](http://en.wikipedia.org/wiki/Public_switched_telephone_network) (where a [bandpass filter](http://en.wikipedia.org/wiki/Bandpass_filter) limits the frequency range to between 300 and 3400 Hz), or over a limited radio frequency band.

The aim of **analog modulation** is to transfer an [analog](http://en.wikipedia.org/wiki/Analog_signal) [baseband](http://en.wikipedia.org/wiki/Baseband) (or [lowpass](http://en.wikipedia.org/wiki/Lowpass)) signal, for example an audio signal or TV signal, over an analog [bandpass](http://en.wikipedia.org/wiki/Bandpass) [channel](http://en.wikipedia.org/wiki/Channel_%28communications%29) at a different frequency, for example over a limited radio frequency band or a cable TV network channel.

Analog and digital modulation facilitate [frequency division multiplexing](http://en.wikipedia.org/wiki/Frequency_division_multiplexing) (FDM), where several low pass information signals are transferred simultaneously over the same shared physical medium, using separate passband channels (several different carrier frequencies).

The aim of **digital baseband modulation** methods, also known as [line coding](http://en.wikipedia.org/wiki/Line_coding), is to transfer a digital bit stream over a [baseband](http://en.wikipedia.org/wiki/Baseband) channel, typically a non-filtered copper wire such as a [serial bus](http://en.wikipedia.org/wiki/Serial_bus) or a wired [local area network](http://en.wikipedia.org/wiki/Local_area_network).

The aim of **pulse modulation** methods is to transfer a [narrowband](http://en.wikipedia.org/wiki/Narrowband) analog signal, for example a phone call over a [wideband](http://en.wikipedia.org/wiki/Wideband) baseband channel or, in some of the schemes, as a bit stream over another [digital transmission](http://en.wikipedia.org/wiki/Digital_transmission) system.

In music synthesizers, modulation may be used to synthesise waveforms with an extensive overtone spectrum using a small number of oscillators. In this case the carrier frequency is typically in the same order or much lower than the modulating waveform. See for example [frequency modulation synthesis](http://en.wikipedia.org/wiki/Frequency_modulation_synthesis) or [ring modulation synthesis](http://en.wikipedia.org/wiki/Ring_modulation#Use_in_music).

**Carrier signal :---**

In [telecommunications](http://en.wikipedia.org/wiki/Telecommunications), a **carrier signal**, **carrier wave**, or just **carrier**, is a [waveform](http://en.wikipedia.org/wiki/Waveform) (usually [sinusoidal](http://en.wikipedia.org/wiki/Sinusoidal)) or sine wave that is [modulated](http://en.wikipedia.org/wiki/Modulation) (modified) with an [input signal](http://en.wikipedia.org/wiki/Signal_%28electrical_engineering%29) for the purpose of conveying information.[[1]](http://en.wikipedia.org/wiki/Carrier_signal#cite_note-1) This carrier wave is usually a much higher [frequency](http://en.wikipedia.org/wiki/Frequency) than the input signal. The purpose of the carrier is usually either to transmit the information through space as an [electromagnetic wave](http://en.wikipedia.org/wiki/Electromagnetic_wave) (as in radio communication), or to allow several carriers at different frequencies to share a common physical transmission medium by [frequency division multiplexing](http://en.wikipedia.org/wiki/Frequency_division_multiplexing) (as, for example, a [cable television](http://en.wikipedia.org/wiki/Cable_television) system). The term is also used for an unmodulated [emission](http://en.wikipedia.org/wiki/Emission_%28electromagnetic_radiation%29) in the absence of any modulating signal.[[2]](http://en.wikipedia.org/wiki/Carrier_signal#cite_note-2)

[Frequency modulation](http://en.wikipedia.org/wiki/Frequency_modulation) (FM) and [amplitude modulation](http://en.wikipedia.org/wiki/Amplitude_modulation) (AM) are common modes of modulating the carrier. In the case of [single-sideband modulation](http://en.wikipedia.org/wiki/Single-sideband_modulation) (SSB), the carrier is suppressed (and in some forms of SSB, eliminated). The carrier must be reintroduced at the receiver by a [beat frequency oscillator](http://en.wikipedia.org/wiki/Beat_frequency_oscillator) (BFO). The frequency of a radio or television station is actually the carrier wave's [center frequency](http://en.wikipedia.org/wiki/Center_frequency).

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