

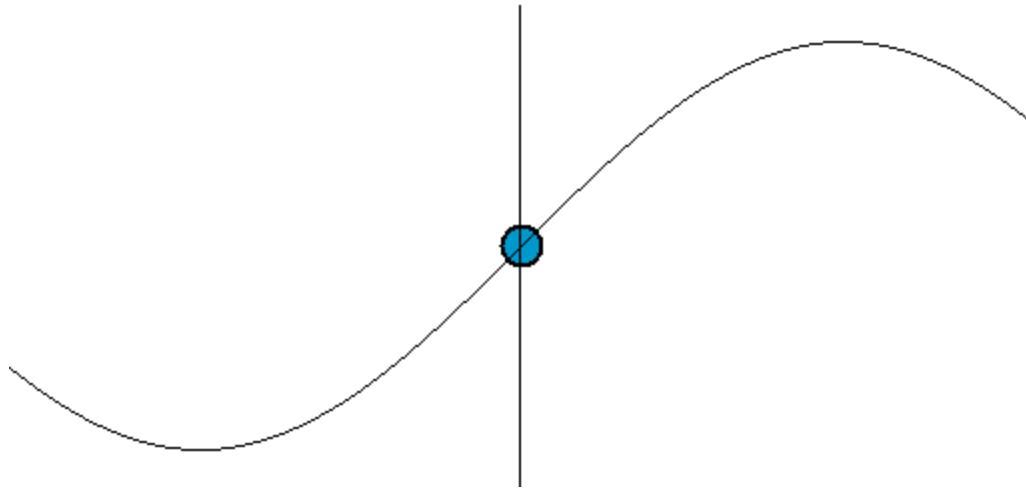
What's a Signal?

It is a stream of energy that
carries information.

It is useful to understand
this stream of energy....

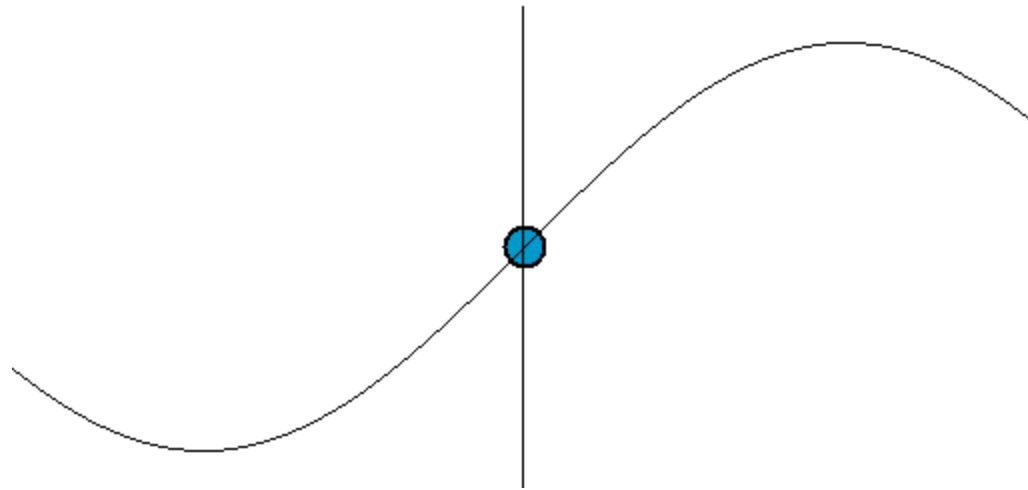
...as one or more waves.

What's a Wave?



A progressive disturbance
propagated from point to point

without progress
or advance by the points
themselves.



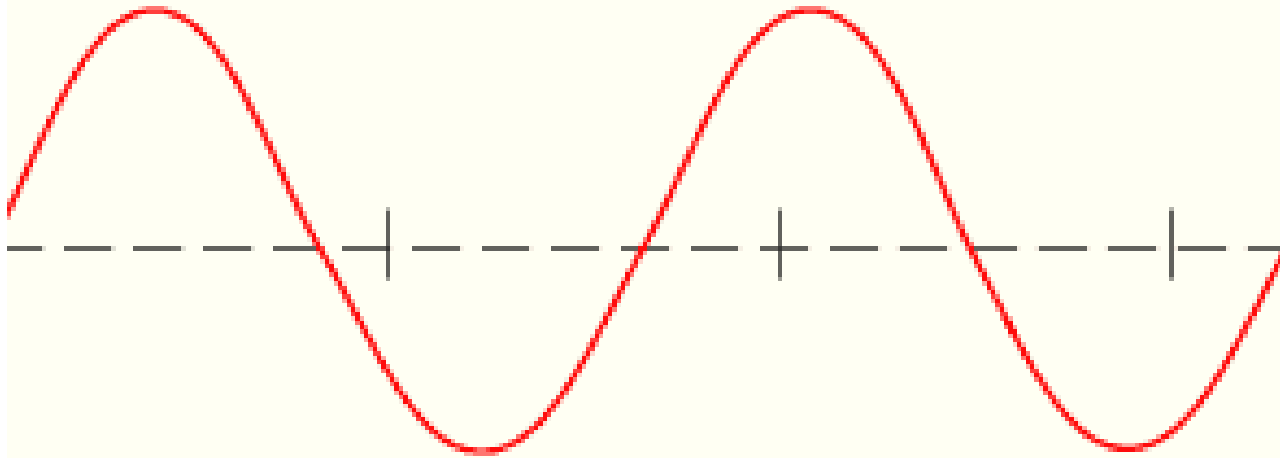
(as in the transmission of
sound or light)

A wave is a progressive disturbance,
propagated from point to point
without progress of the points
themselves.

The Anatomy of a Wave

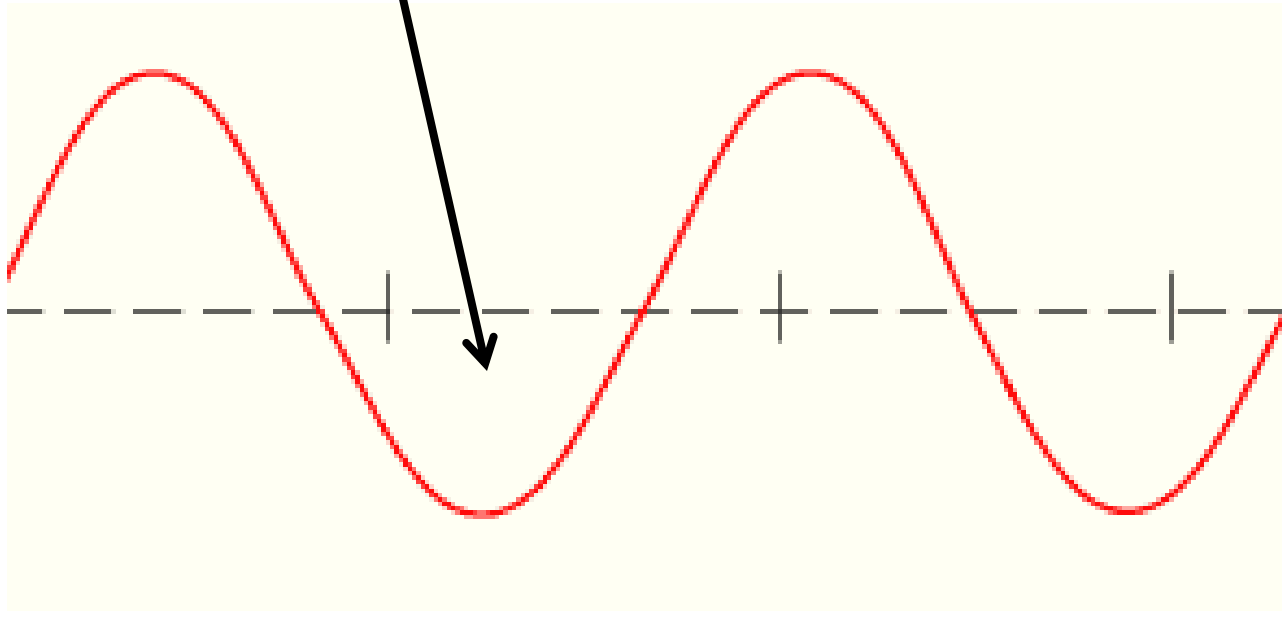
A Peak is...

The highest point on the wave



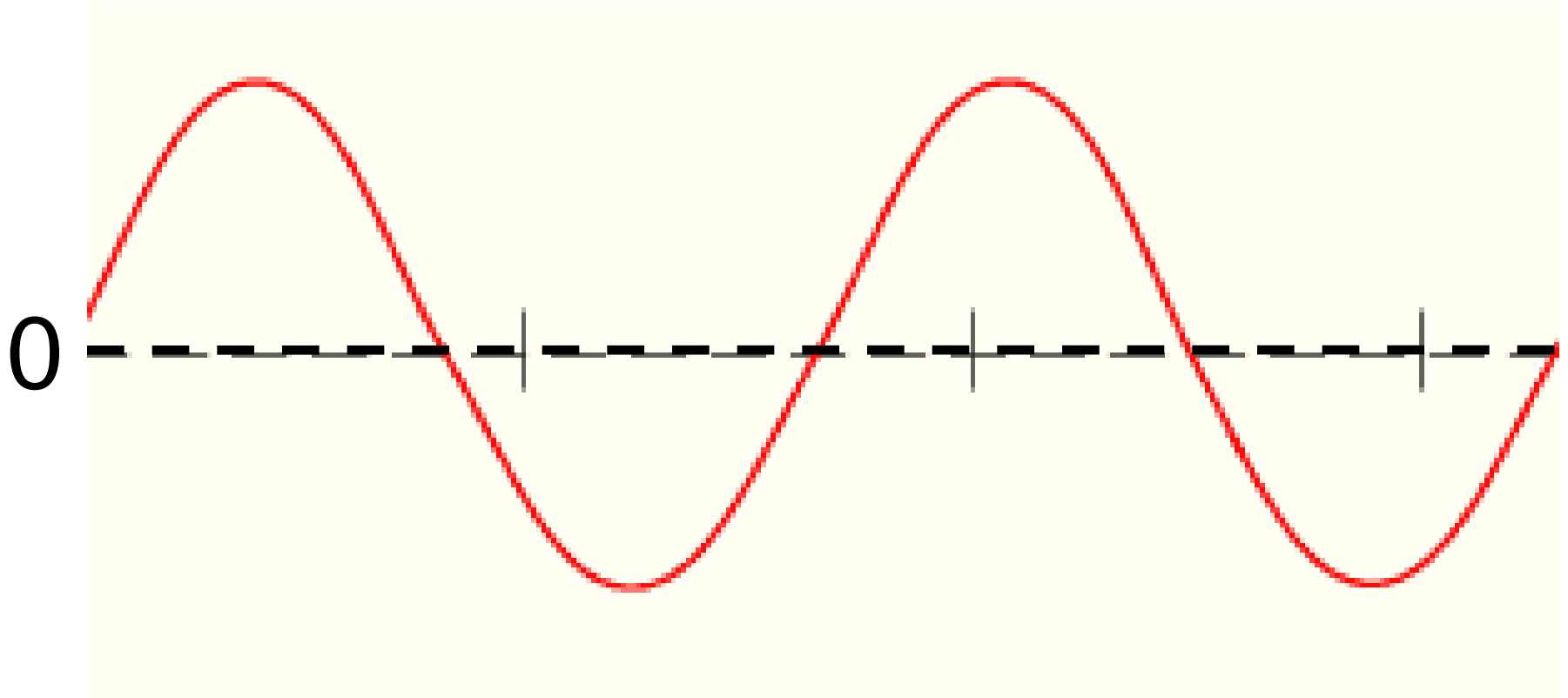
A Trough is ...

The lowest point on the
wave



The Zero Crossing is the axis

(The point at which the wave values go from positive to negative)



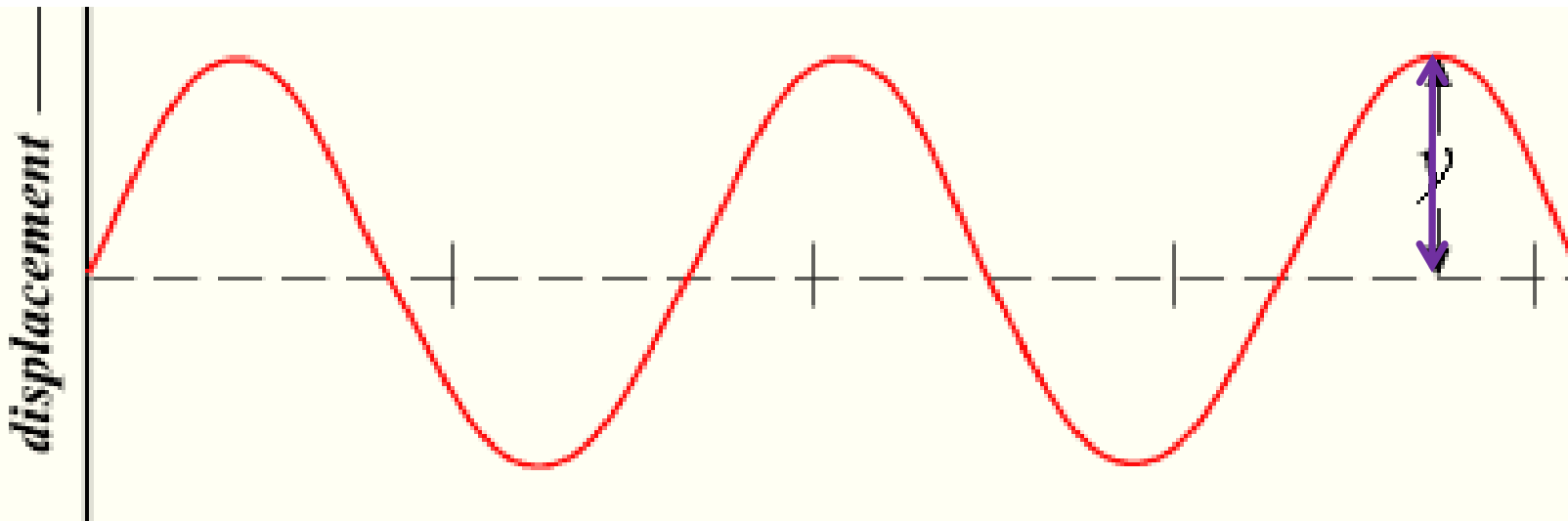
These basic parts:
Peak
Trough
& Zero Crossing

Are used to define the 3
important features of waves:

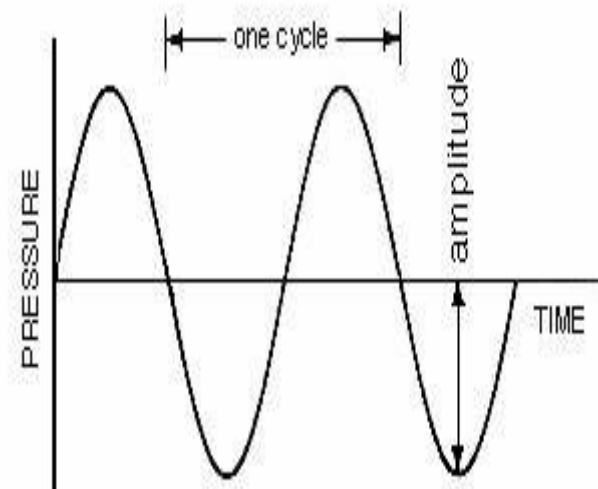
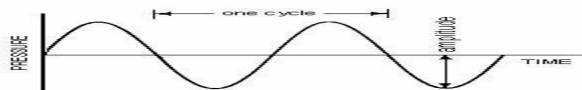
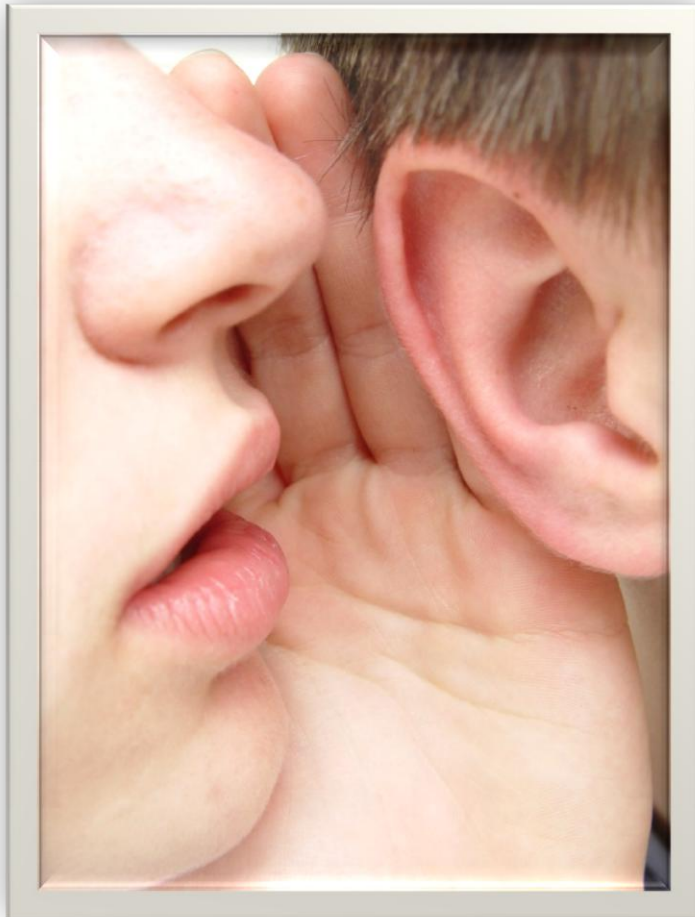
Amplitude
Frequency
& Phase

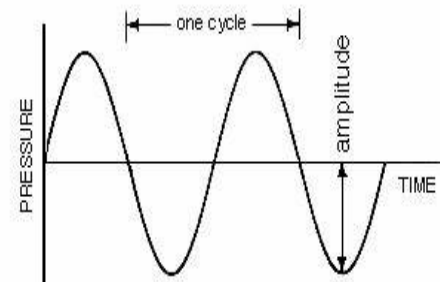
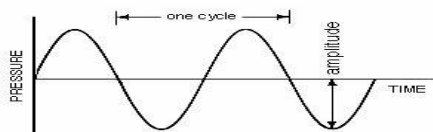
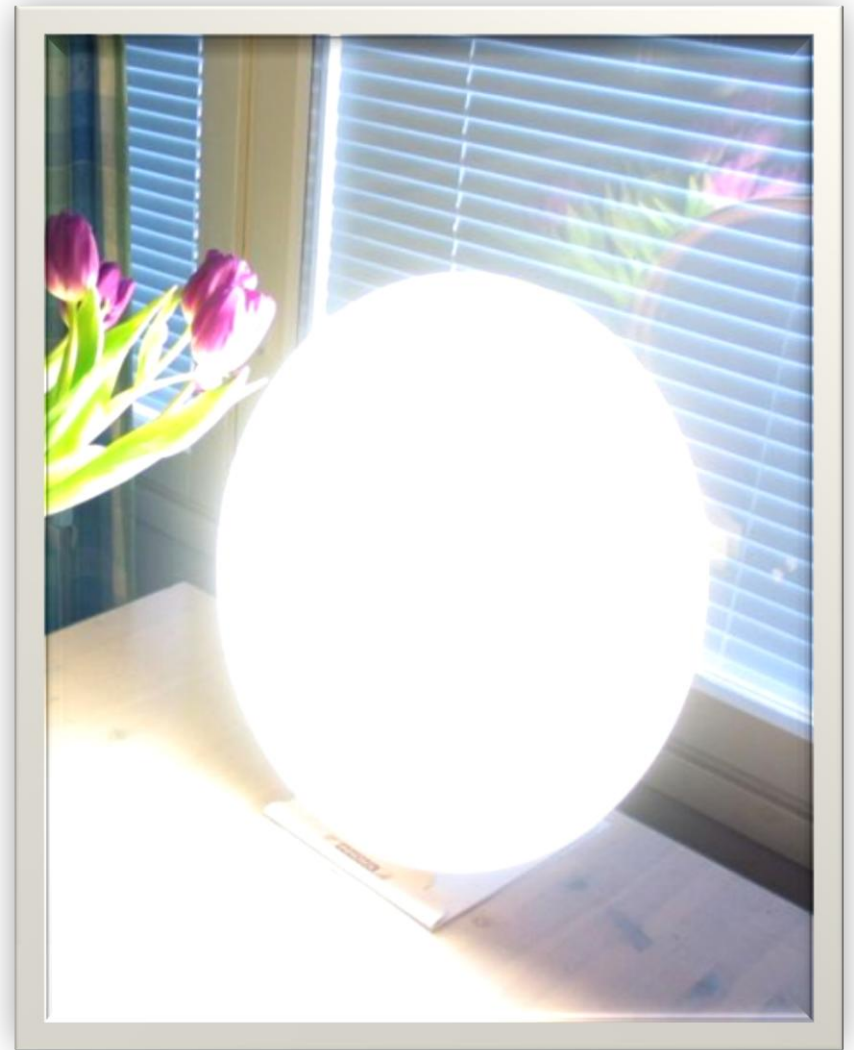
Amplitude

The maximum disturbance from the zero crossing (undisturbed position)



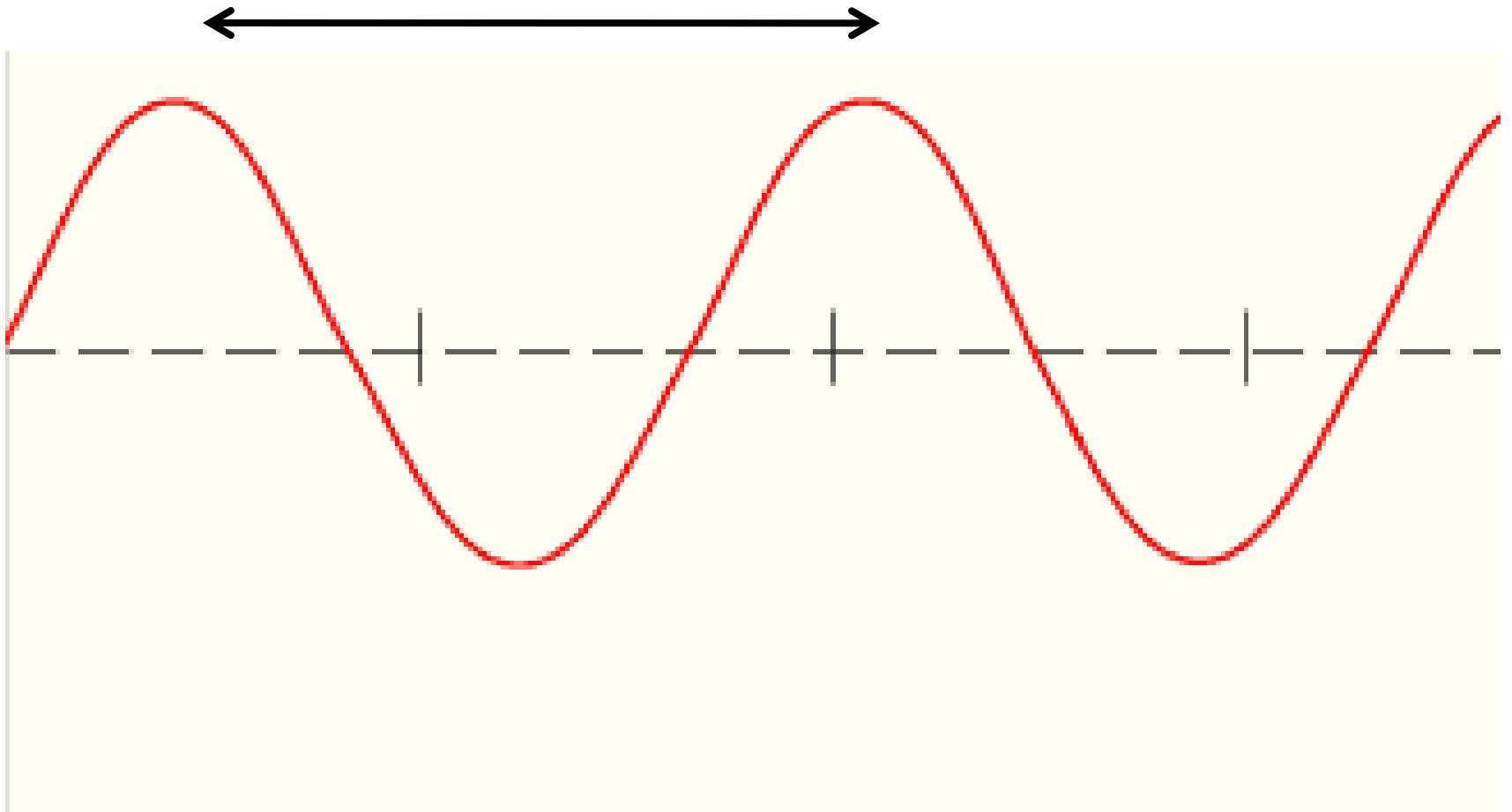
Amplitude corresponds
roughly to terms like loudness
or intensity





Frequency

A single event that gets repeated is a **cycle**



Frequency is the number of
cycles per second

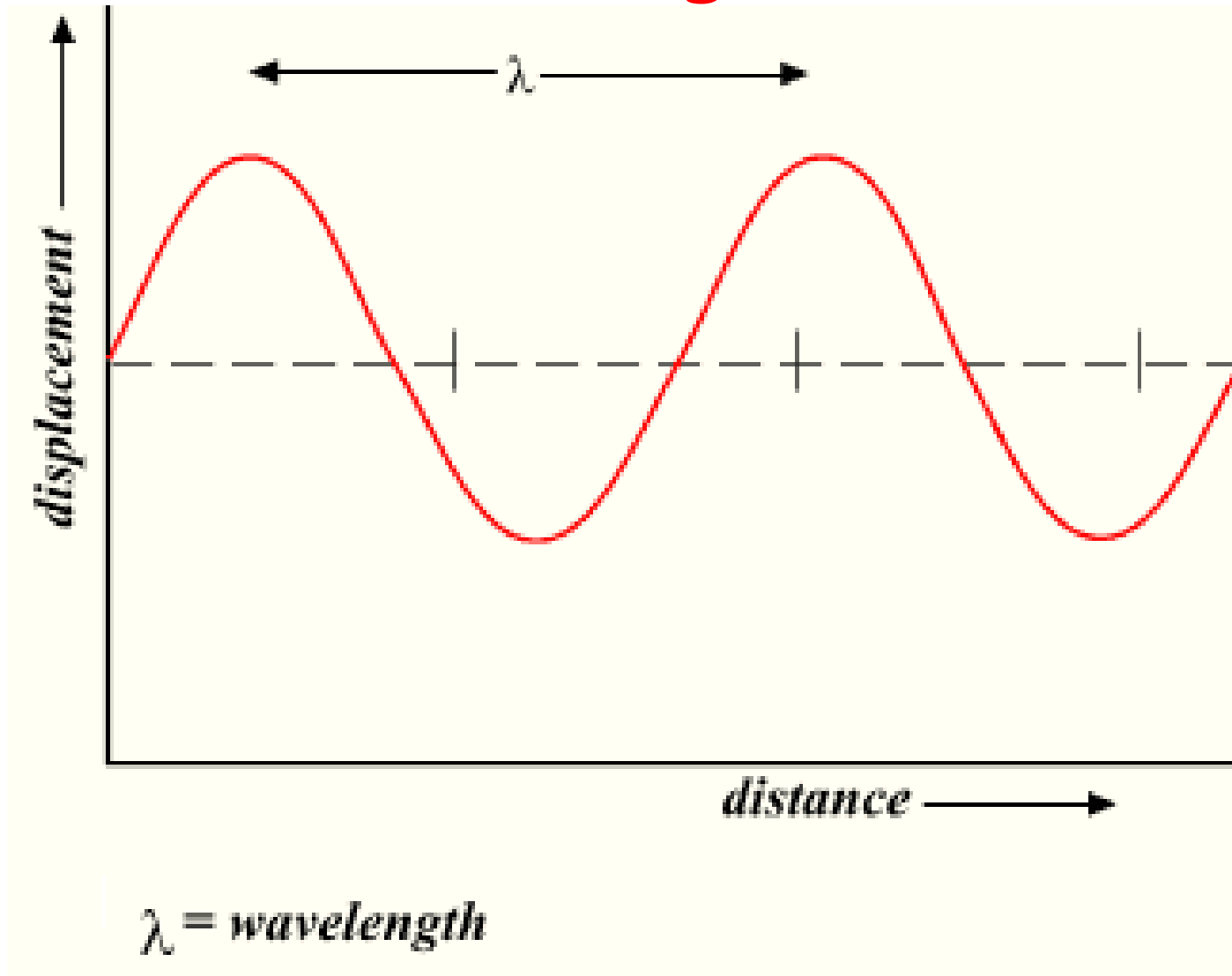
1 cycle per second
=
1 Hertz (Hz)

The time it takes to repeat the cycle is its **period**.

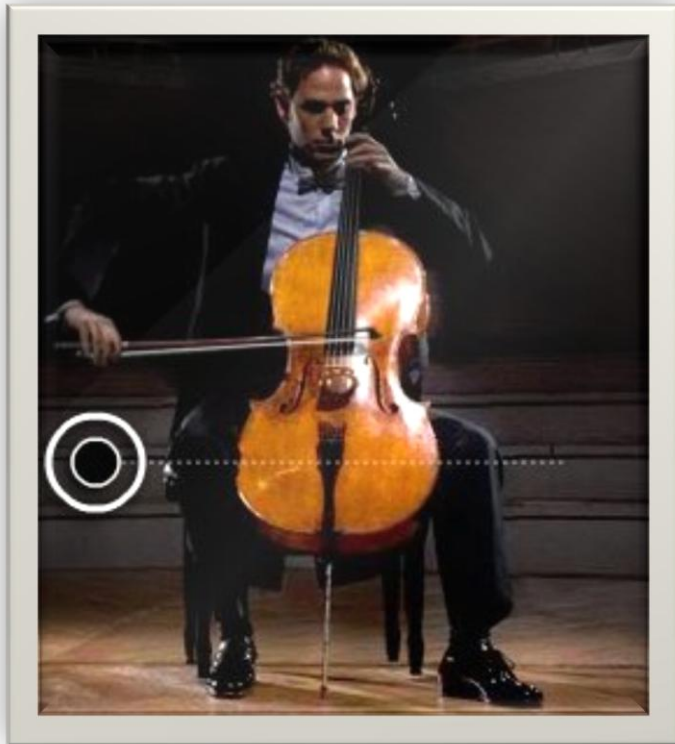
Period is the reciprocal of frequency:

Frequency (Hz)	Period
1000 Hz	1/1000 of a second
2 Hz	$\frac{1}{2}$ a second
1 Hz	1 second

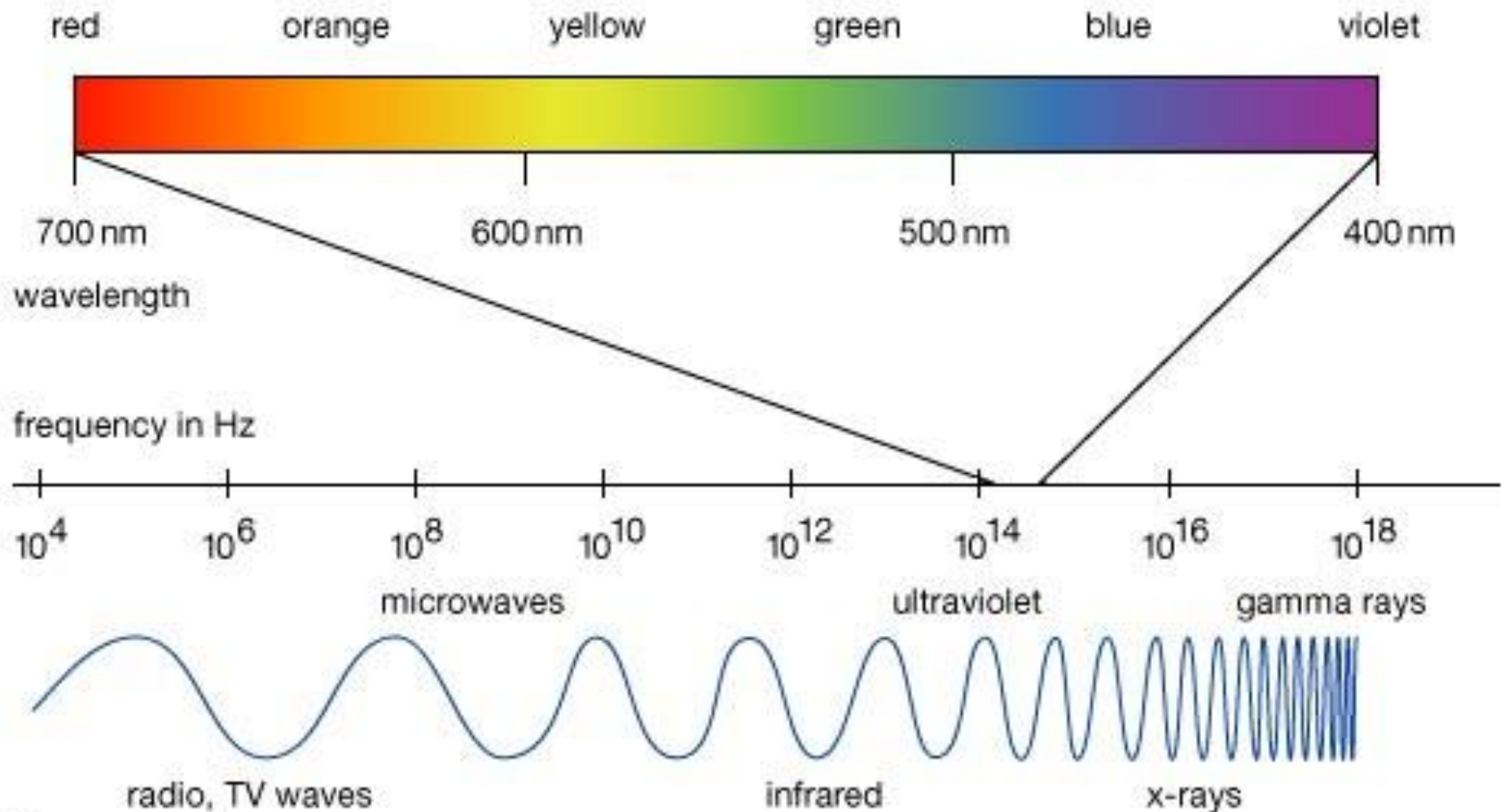
The length of the cycle is its
wavelength



The wavelength of audible sound ranges from ~ 20 Hz (17 m) to 20 kHz (17 mm)



Visible light ranges from **deep red, ~700 nm**, to **violet, ~400 nm**



Wavelength=

Wave velocity/Frequency

$$\lambda = \frac{v}{f}$$



And wave
velocity varies
with medium



So, a **cycle** is a repeating structure with a **period** (time) and **wavelength**

Frequency is the number of
cycles per second

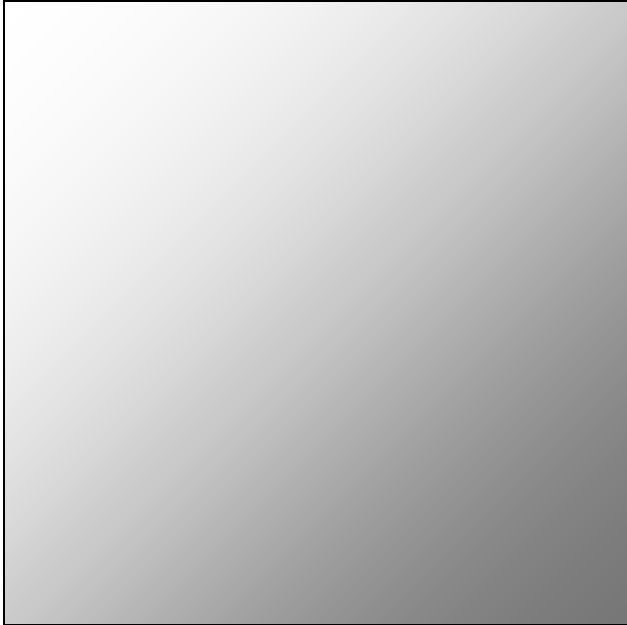
At least, that's **temporal**
frequency

What else is there?

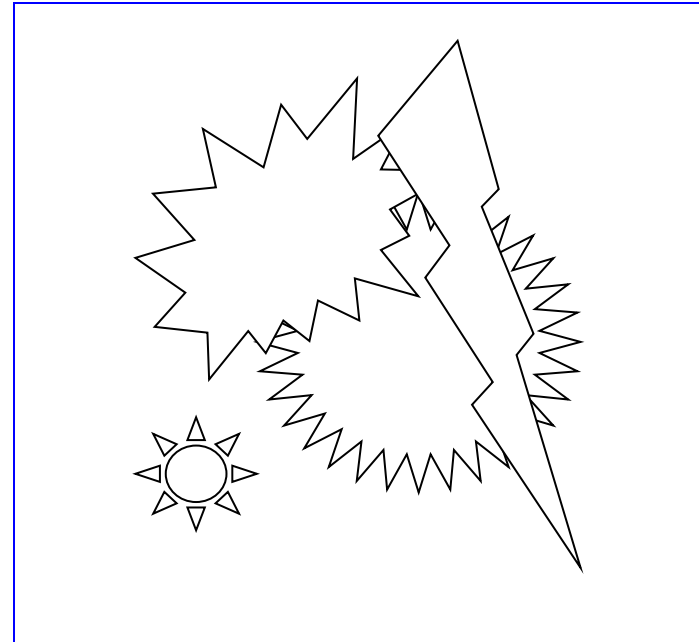
Well, there's something called
spatial frequency:

A measure of how often a
structure repeats per unit of
distance.

Spatial Frequency

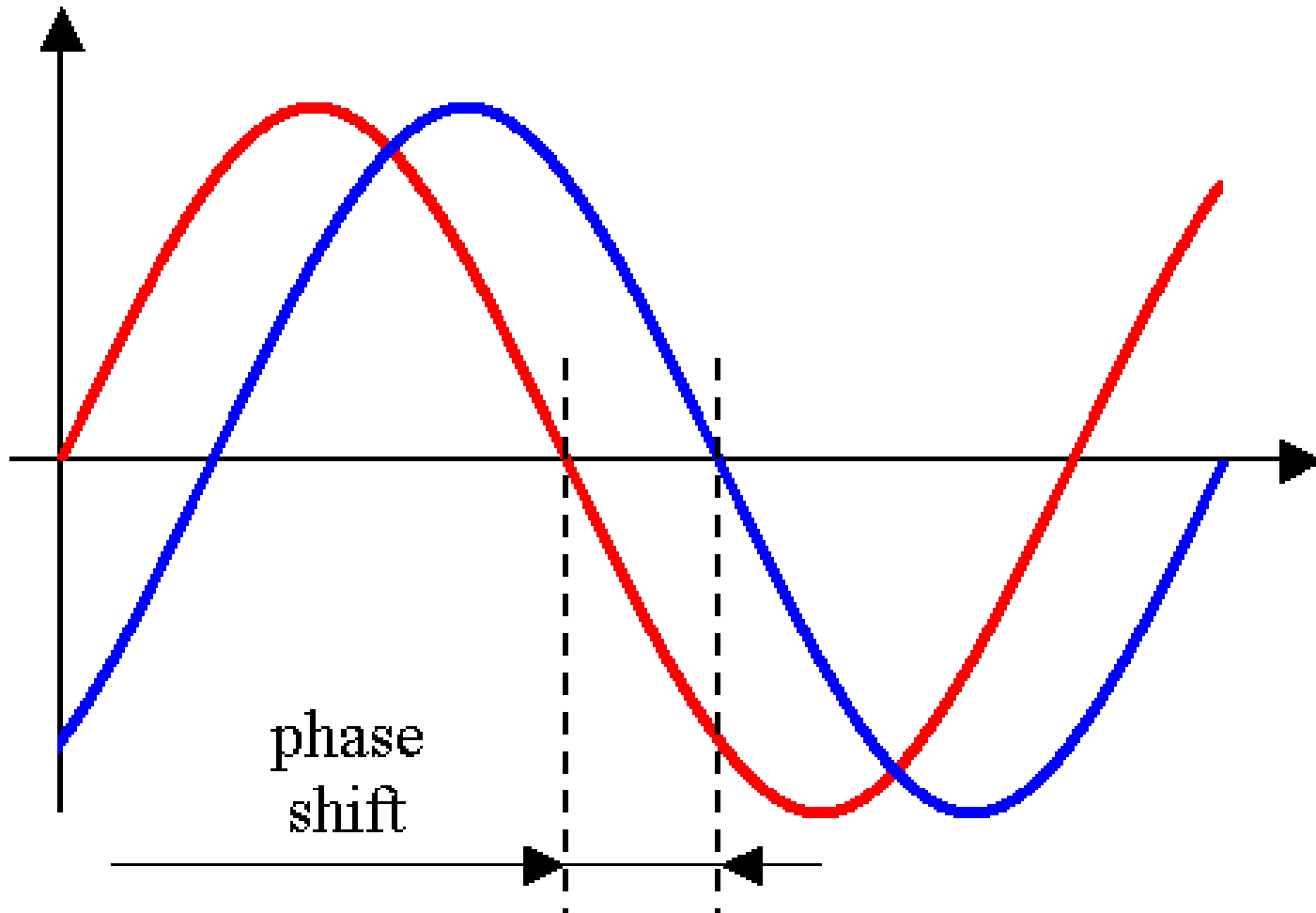


Low Frequency:
Slow global
changes



High Frequency:
Abrupt changes,
detail and edges

Phase is the temporal offset
of a cycle



Summary

Signals are waves.

Waves have amplitude, frequency and phase.

Amplitude, frequency and phase are defined relative to peaks, troughs and zero crossings of the wave.

Frequency can be in temporal units or spatial units.

Concepts

Wave

- Peak, trough, zero crossing

Amplitude

Frequency (Temporal and Spatial)

- Cycle, period, wavelength

Phase