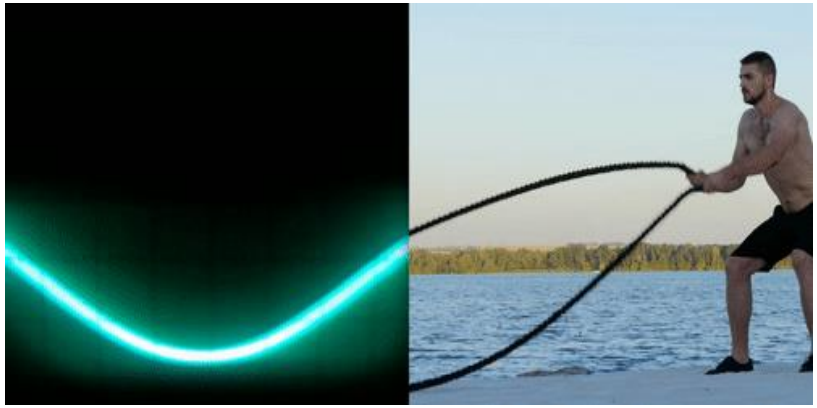
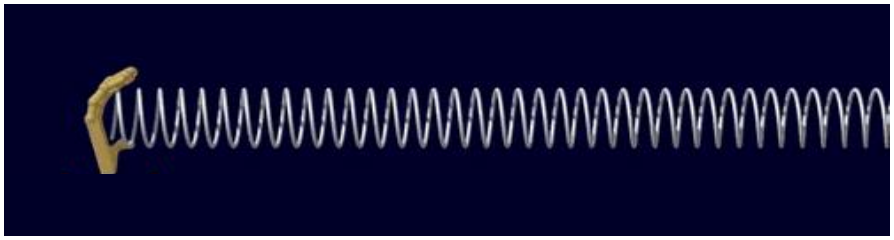
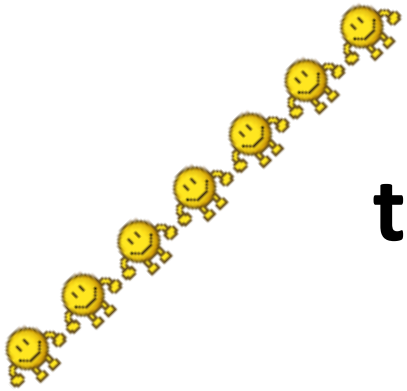
Introduction to
WAVES





A **wave** is a kind of **oscillation** (disturbance, vibration) that **transports energy** from place to place through space and matter.



WAVES

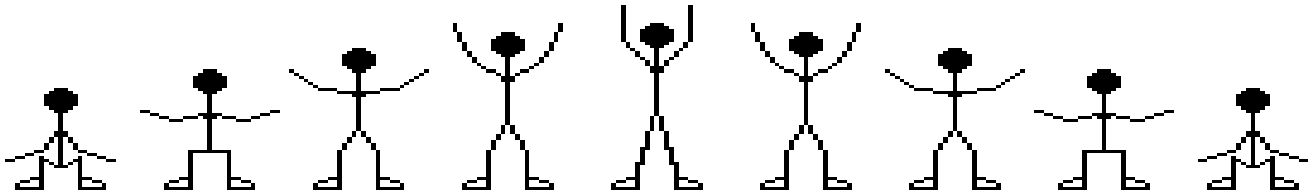
MECHANICAL:

- oscillations of *matter*
- require a medium

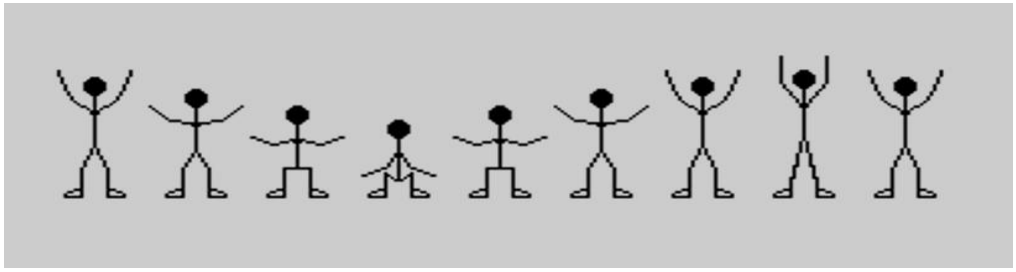
ELECTROMAGNETIC:

- oscillations of *electric and magnetic field*
- require no medium

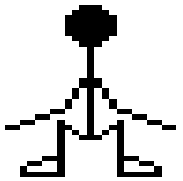
How to describe a wave?



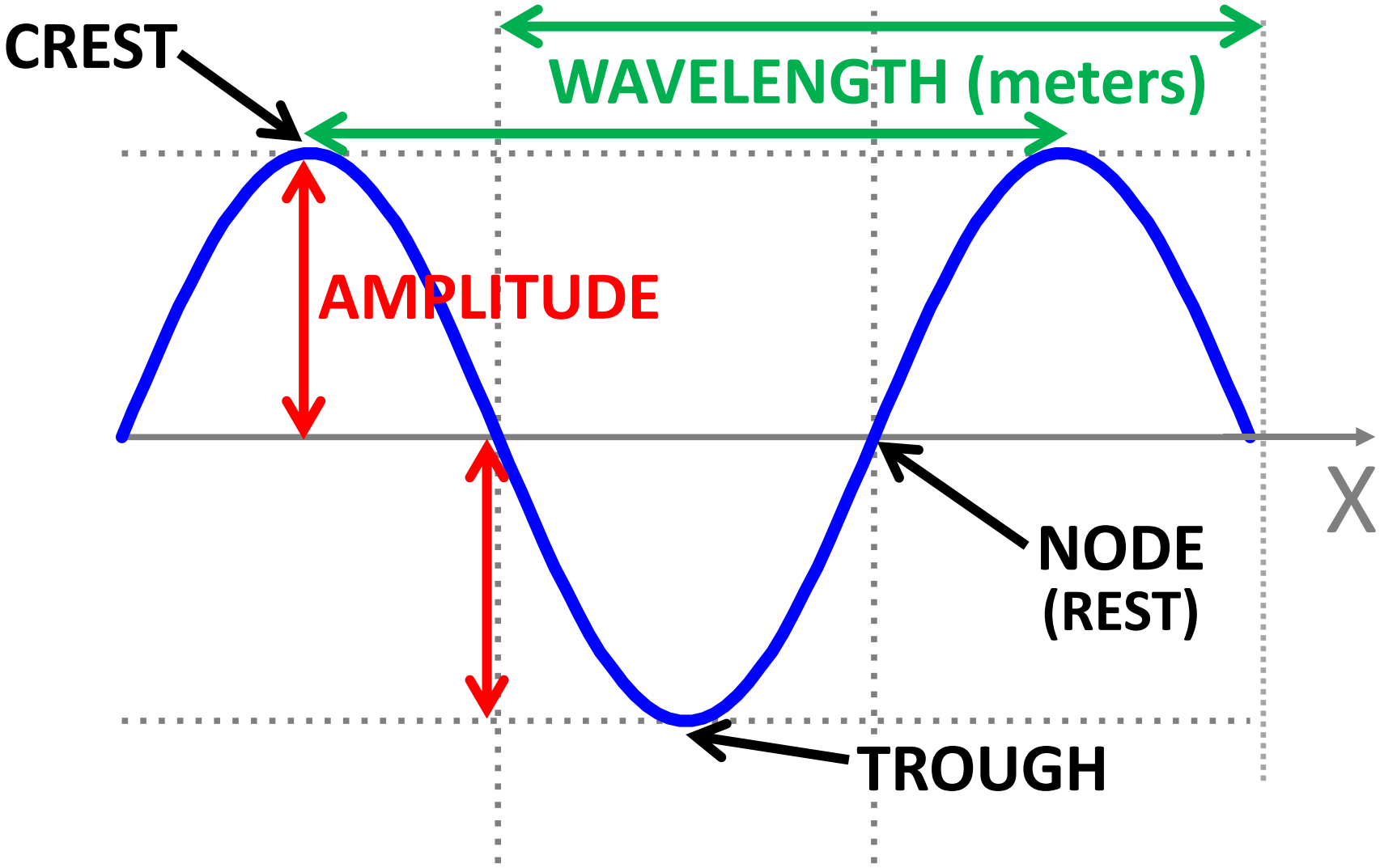
1. Take a "snapshot" – look at wave shape through space at a particular moment in time.



2. Watch a particular point over time.



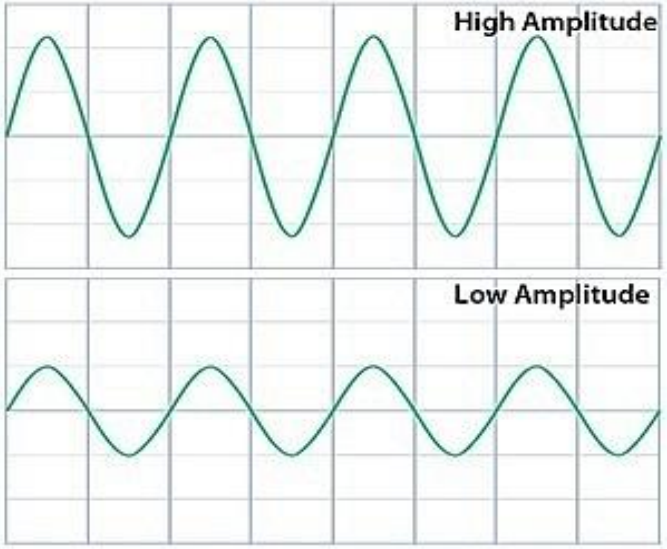
How to describe a wave in space?

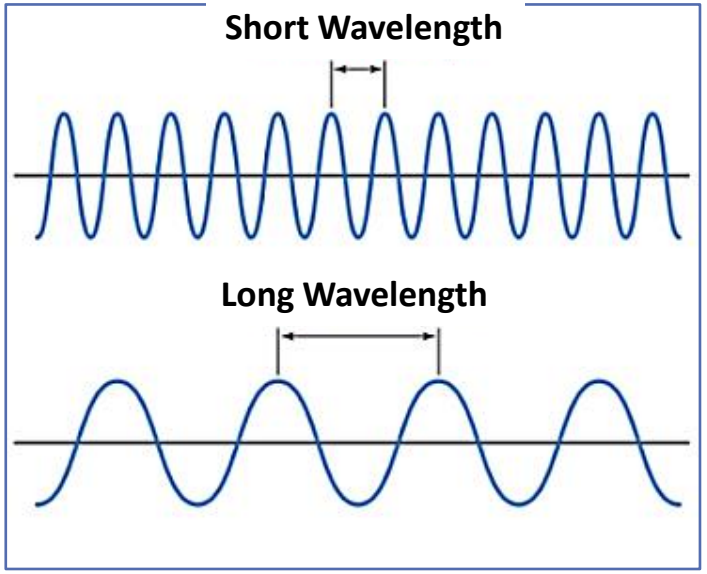


Notations and Units

AMPLITUDE (A): maximum amount of vibration measured from the rest position.

- **Unit of measurement: depends on the physical quantity that is oscillating**
- **Examples: distance (meters), pressure (pascals), electric field strength (volts/meter)**

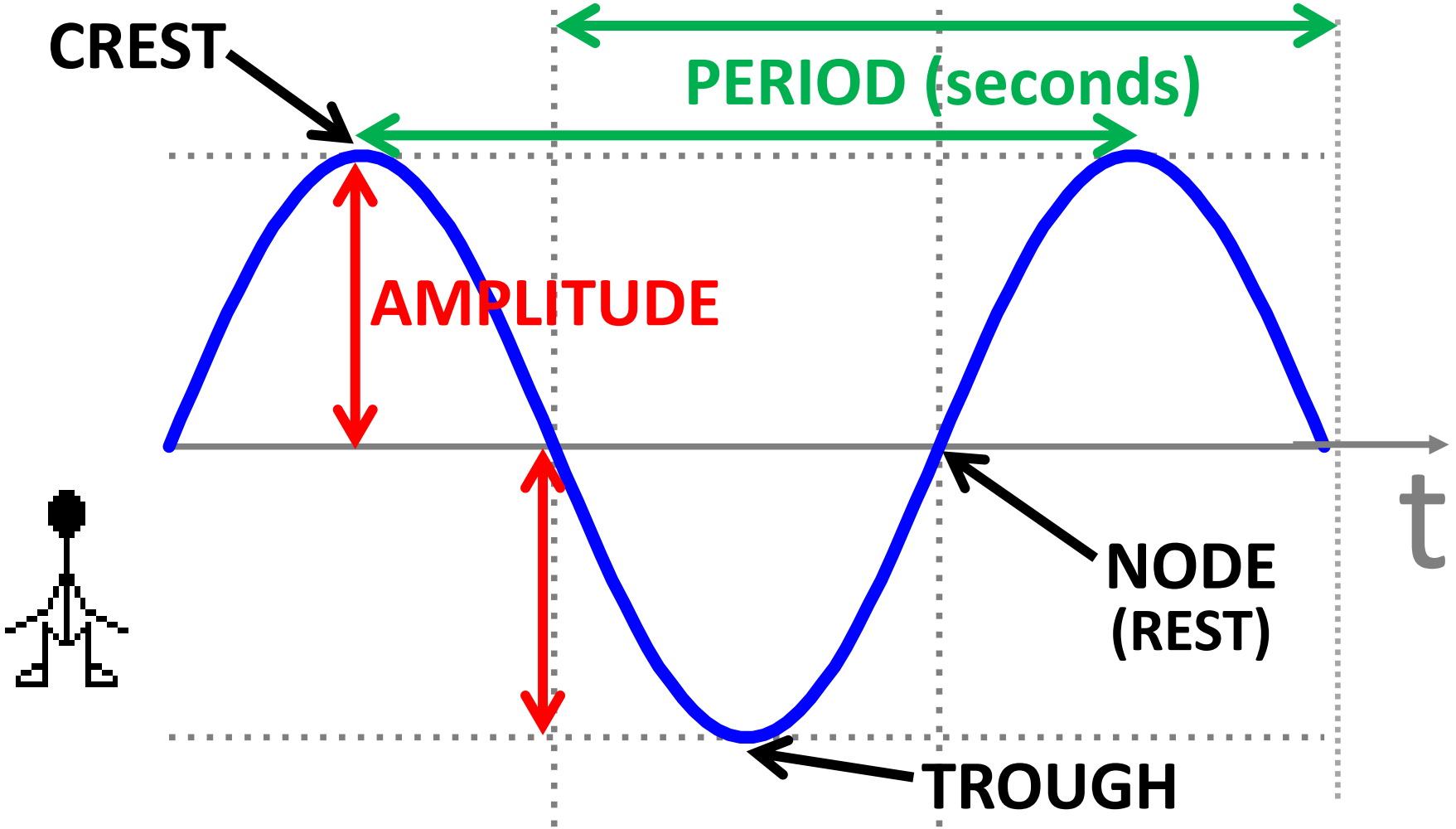




WAVELENGTH (λ): the distance over which the wave's shape repeats itself.

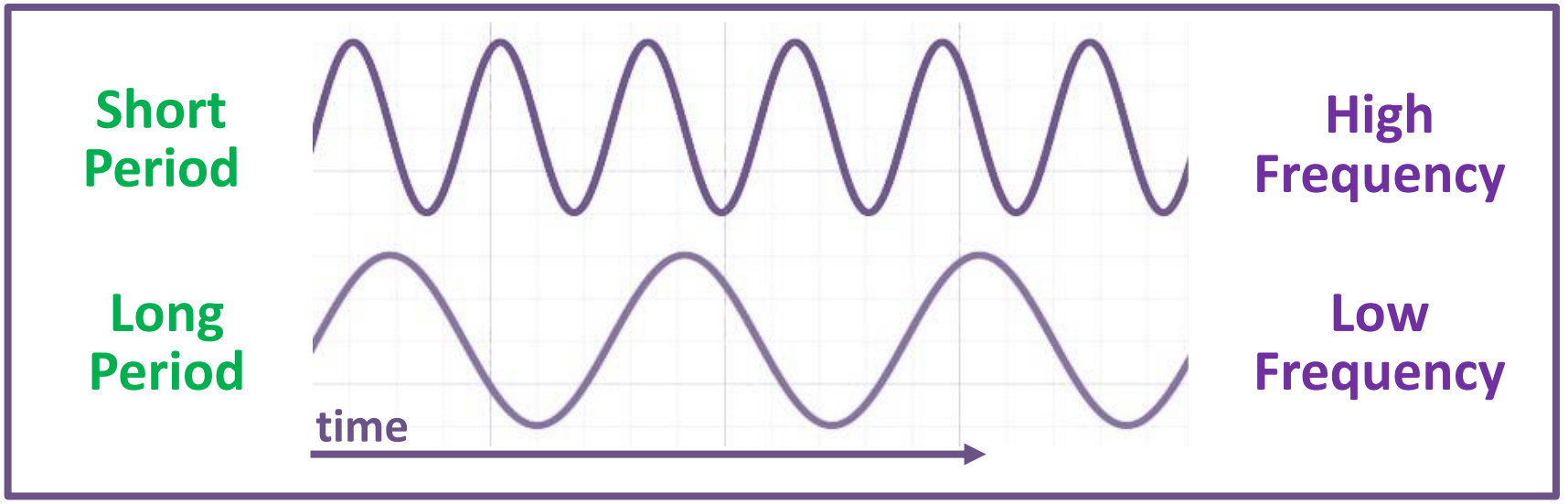
- **Unit of measurement: meters**
- **Examples: the sounds of thunder are waves with wavelengths from few tenths to a few meters; the wavelengths of visible light are in the range of 400 to 750 *nanometers* (billionths of a meter)**

How to describe a wave in time?



FREQUENCY: number of waves per second

Notations and Units



PERIOD (T): The time it takes to make one complete vibrational cycle.

- Unit of measurement: seconds

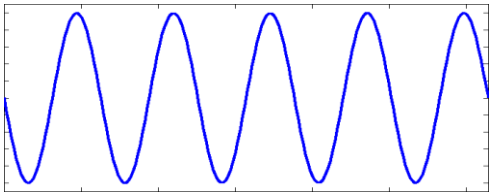
FREQUENCY (f): number of waves per second.

- Unit of measurement: hertz (Hz)

$$\text{FREQUENCY} = \frac{1}{\text{PERIOD}}$$

$$1\text{Hz} = \frac{1}{1\text{s}}$$

Exercise: match wave parameters with descriptions.



ANSWER	PARAMETER	DESCRIPTION *(in mixed order!)*
C	CREST	A. Maximum amount of vibration from the rest position; can be measured to the crest or to the trough.
G	THROUGH	B. The distance over which the wave's shape repeats itself in space.
F	NODE (REST)	C. The highest (maximum) point of a wave.
A	AMPLITUDE	D. Number of waves per second.
B	WAVELENGTH	E. The time it takes to make one complete vibrational cycle.
E	PERIOD	F. Equilibrium position of a wave.
D	FREQUENCY	G. The lowest (minimum) point of a wave.

Can you identify two different kinds of mechanical waves that are created when someone plays a musical instrument?

What vibrates and where?