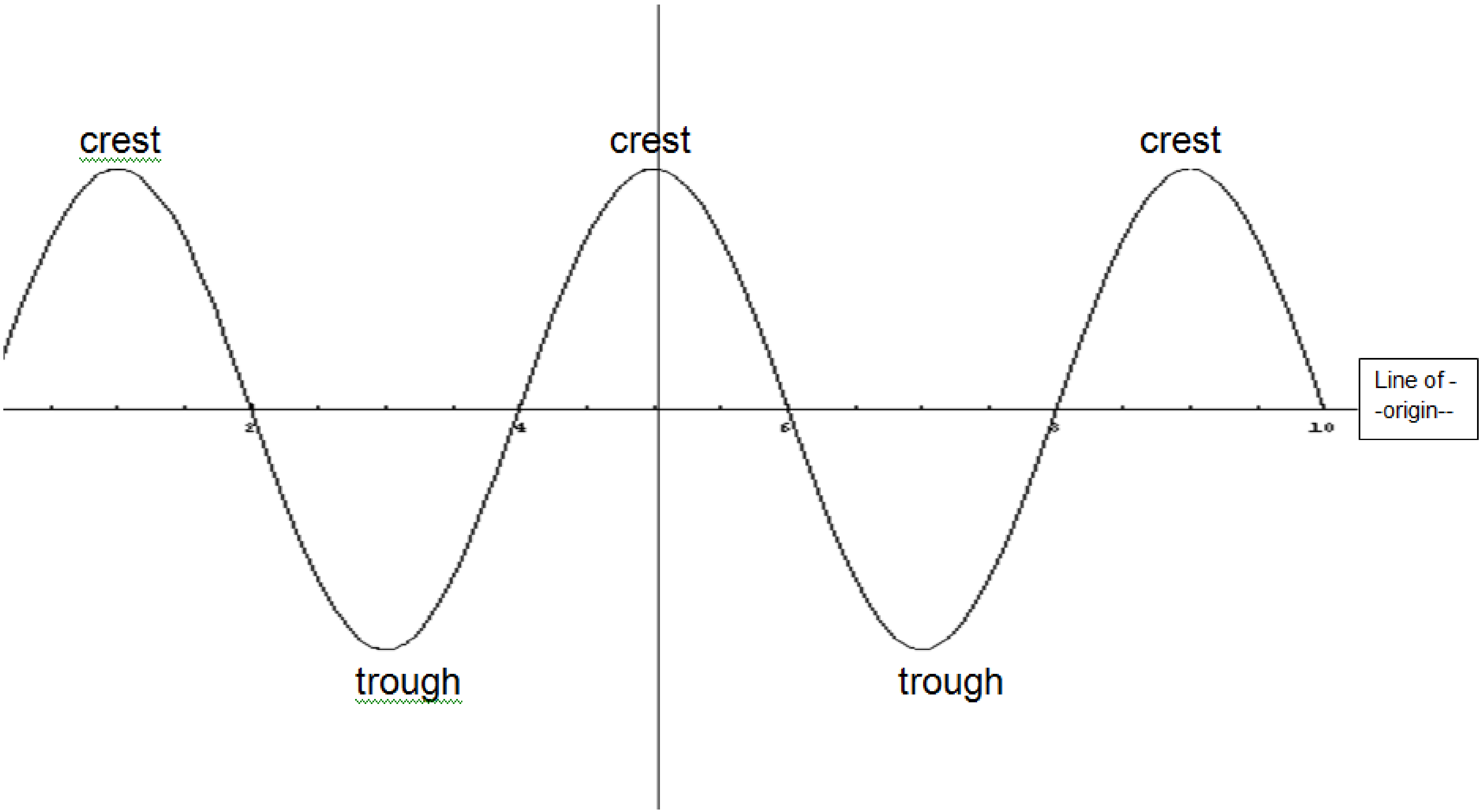
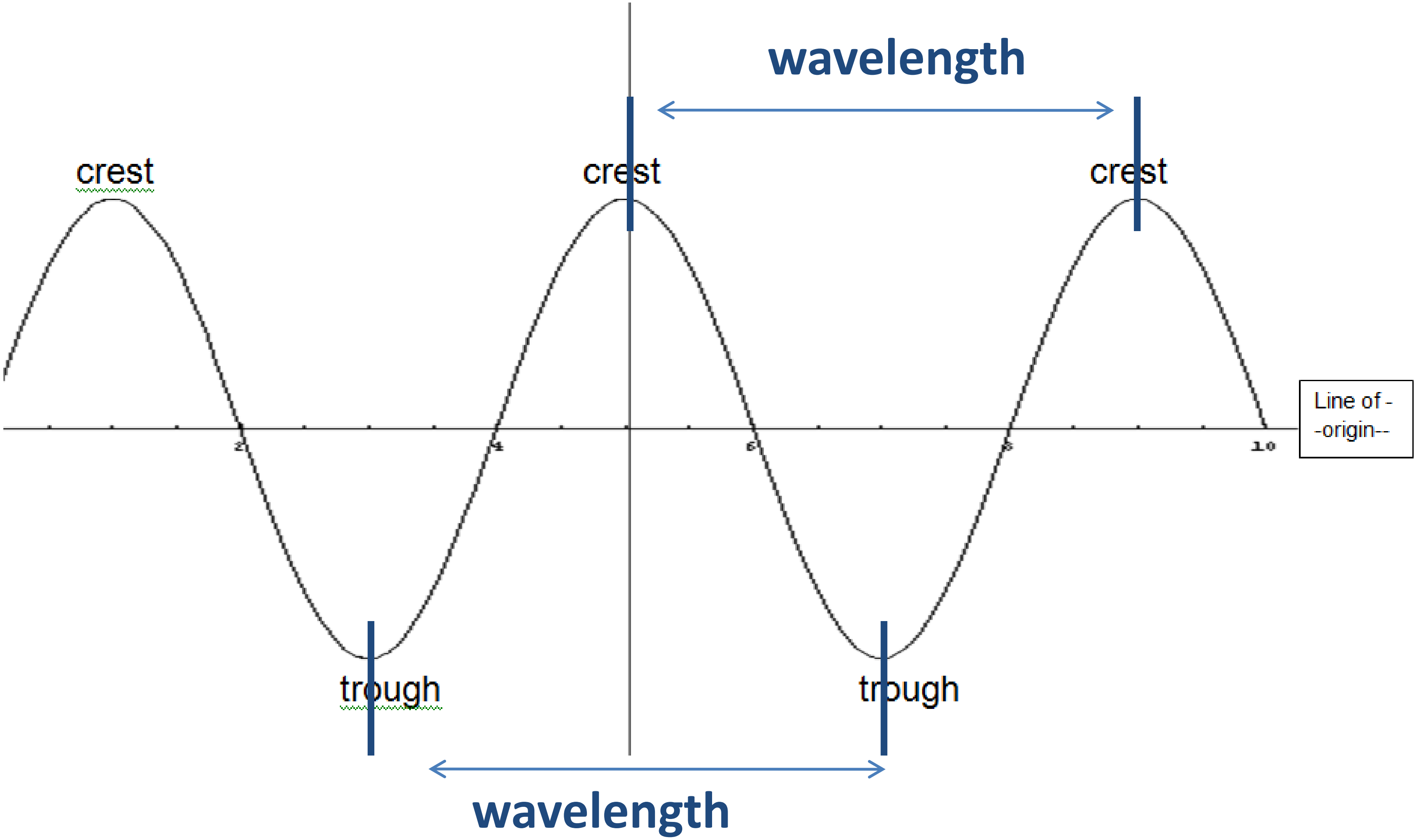
Anatomy of a wave

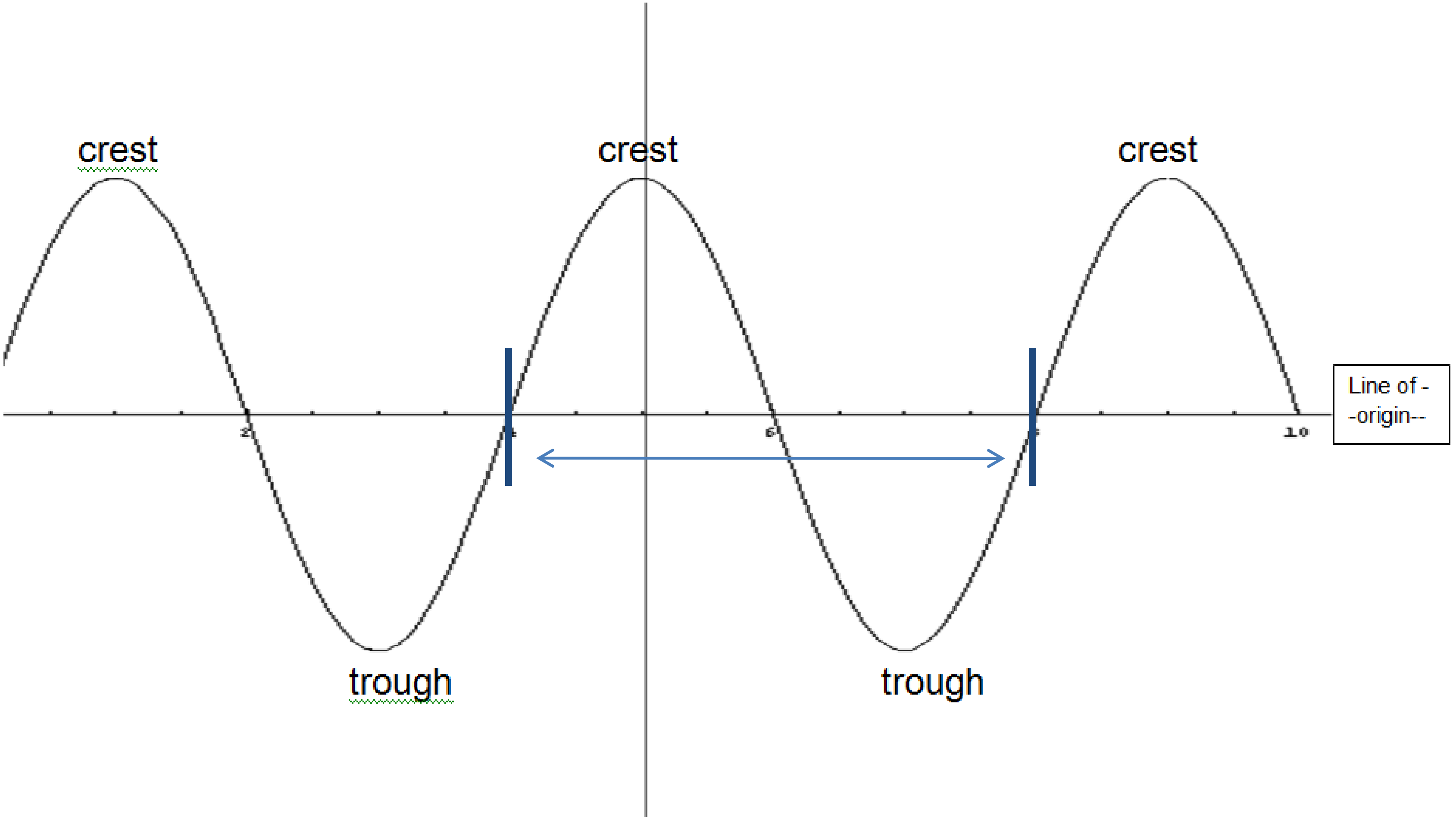




Wavelength is denoted by λ

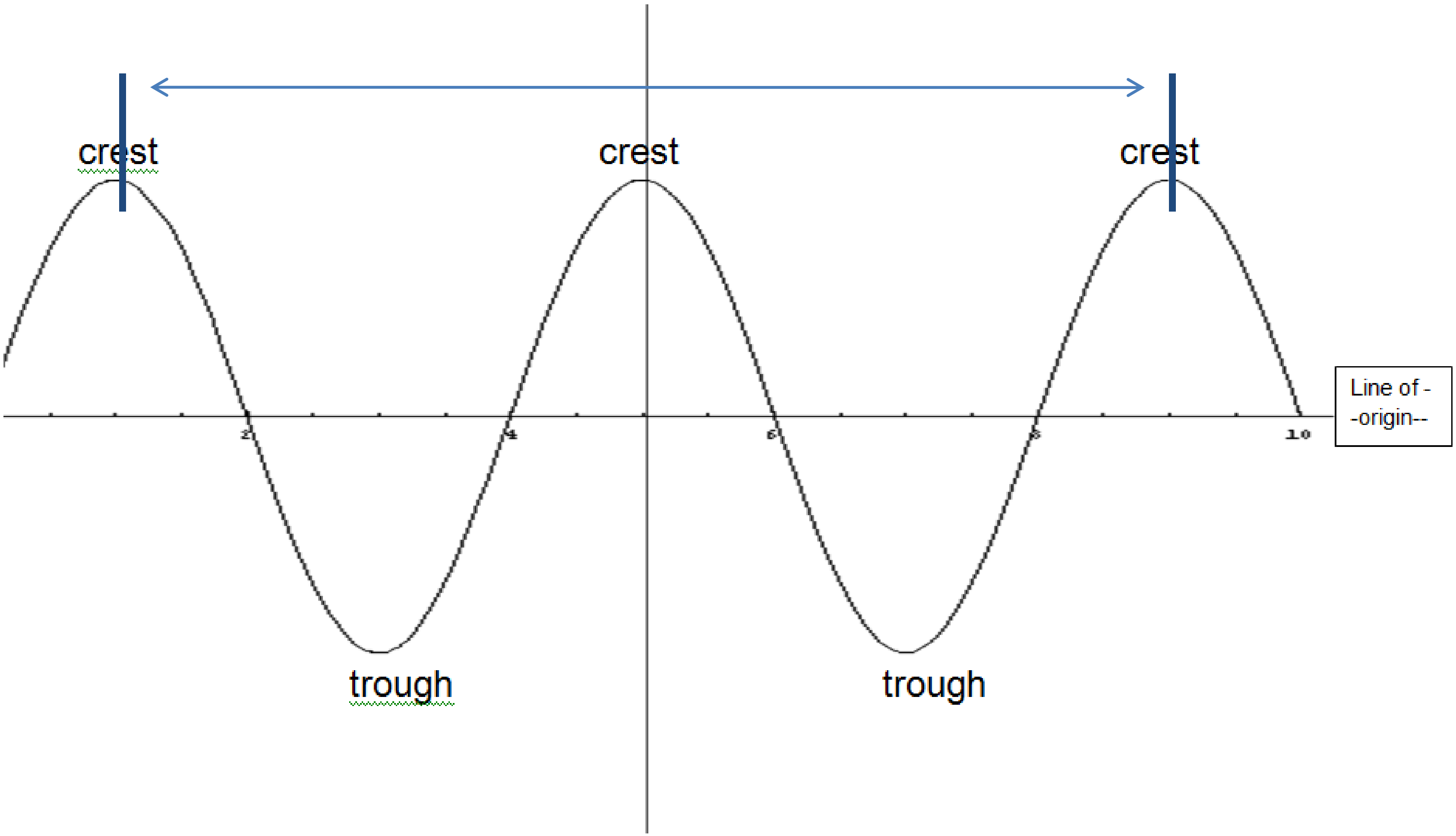
Is this a wavelength (λ)?

A: Yes   B: No



Is this a wavelength (λ)?

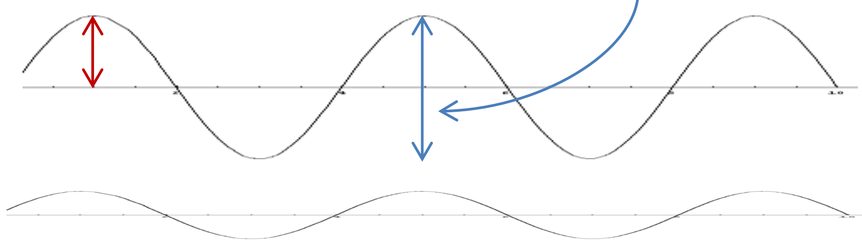
A: Yes   B: No



What is

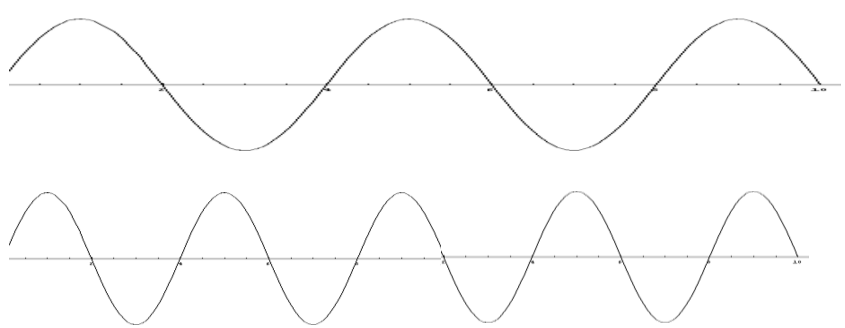
- **Amplitude (A)?**
  - How high/low the crests/troughs are.

Sailors care about wave height – not amplitude!



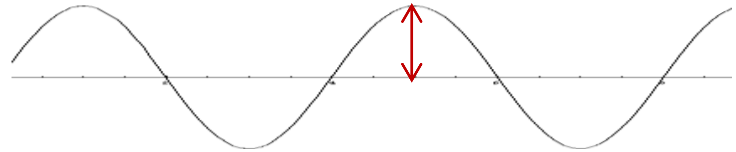
Lower amplitude

- **Frequency (*f*)?**
  - Rate of the oscillation



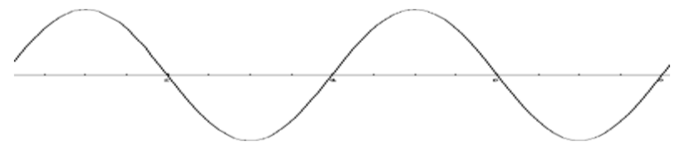
Higher frequency

- **Amplitude (A)**
  - m (meters)

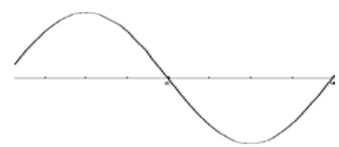


- **Frequency (*f*)**
  - Number of oscillations per second
  - 1/s or Hz (hertz)

2 Hz



- **Period (T)**
  - Time for one oscillation



0.5 s

$$f = 1/T$$

2 Hz = 1/0.5 s

Wave Speed

Wave on a String Homework:

Does the speed of the wave depend on

- Amplitude? A – Yes, B – No
- Frequency? A – Yes, B – No
- Damping? A – Yes, B – No
- Tension? A – Yes, B – No

Imagine a concert

- What if wave speed depended on *frequency*?
  - -high notes would arrive before low notes
  - -or vice versa

- What if wave speed depended on *amplitude*?
  - -louder notes would arrive before quieter notes
  - -or vice versa

- What if wave speed depended on *tension*?
  - -That’s how you tune stringed instruments

Wave Speed

Wave on a String Homework:

Does the speed of the wave depend on

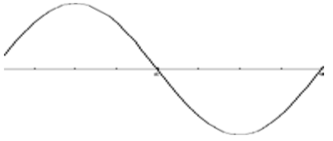
- Amplitude? A – Yes, B – **No**
- Frequency? A – Yes, B – **No**
- Damping? A – Yes, B – **No**
- Tension? A – **Yes**, B – No

Have to change the characteristics of the string

Wave Speed

Wave speed is constant for a given medium.

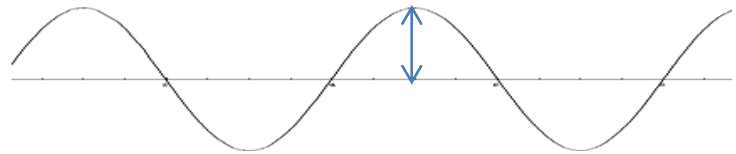
$v = \Delta x / \Delta t$



$v = \lambda / T$ wavelength / Period

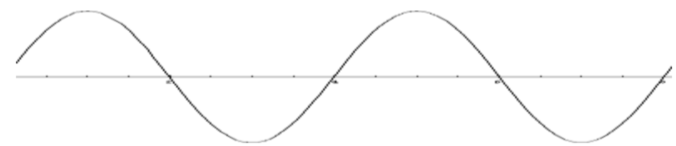
and we know $1/T = f$

- **Amplitude (A)**
  - m (meters)

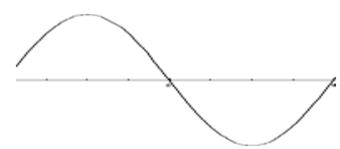


- **Frequency (*f*)**
  - Number of oscillations per second
  - 1/s or Hz (hertz)

2 Hz



- **Period (T)**
  - Time for one oscillation



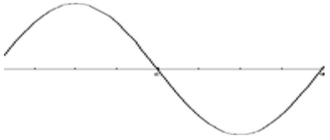
0.5 s

$f = 1/T$

2 Hz = 1/0.5 s

Wave Speed

Wave speed is constant for a given medium.



$v = \Delta x / \Delta t$

$v = \lambda / T = \lambda \ \ 1/T$ wavelength / Period

and we know $1/T = f$

So $\boxed{v = \lambda f}$

So $\lambda = v/f$ or $f = v/\lambda$

Wave Speed

Wave speed is constant for a given medium.

$\lambda = v/f$ *or* $f = v/\lambda$

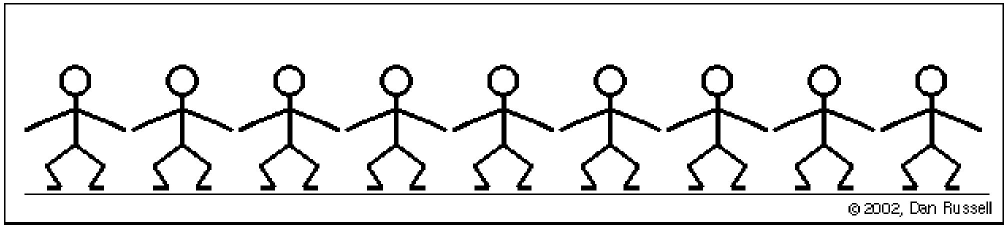
Can get *wavelength* from *frequency*

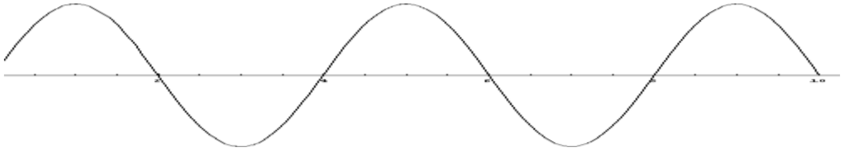
Or

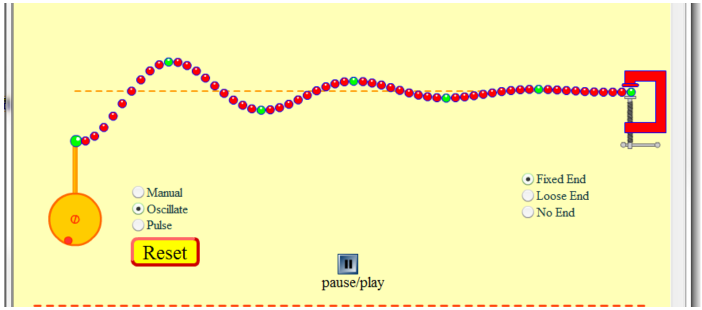
Frequency from the *wavelength*

Types of Waves

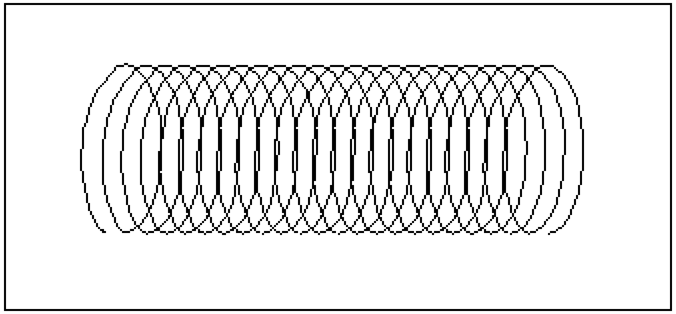
Transverse Waves







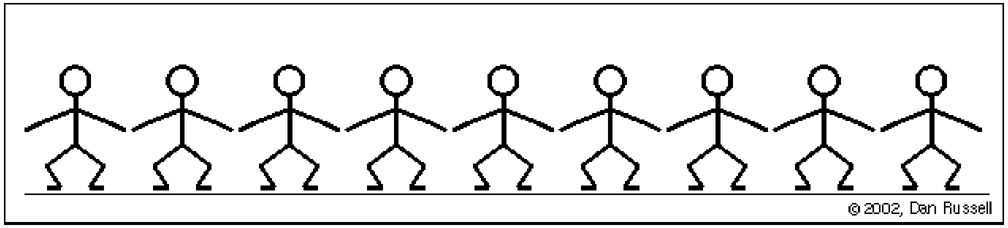
Longitudinal Waves



[Transverse, Longitudinal, and Periodic Waves]

Source, Receiver & Medium

- People Wave



What is the *Source*?

first person

What is the *Receiver*?

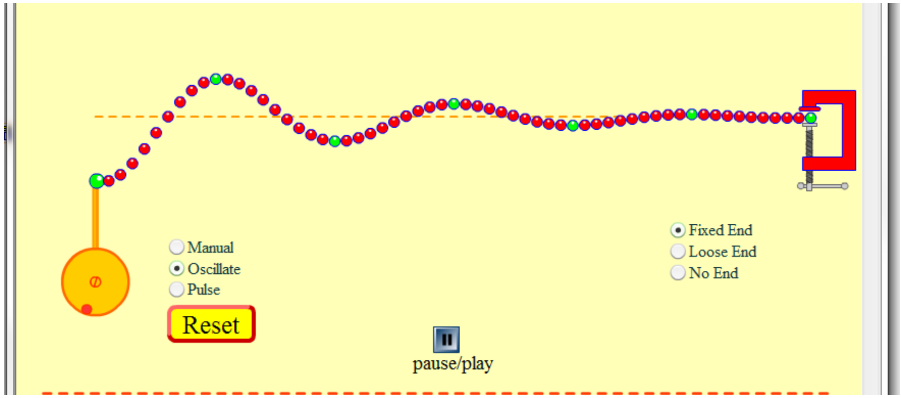
last person

What is the *Medium?*

all the people

Source, Receiver & Medium

- Wave on a String



What is the *Source*?

Orange Pump

What is the *Receiver*?

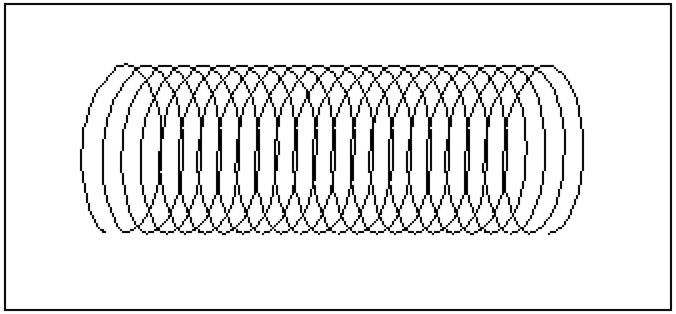
Clamp

What is the *Medium?*

The string of red beads

Source, Receiver & Medium

- Longitudinal slinky wave



What is the *Source*?

start of slinky

What is the *Receiver*?

start of slinky

What is the Medium?

The slinky

How do waves add?

Interference of Waves

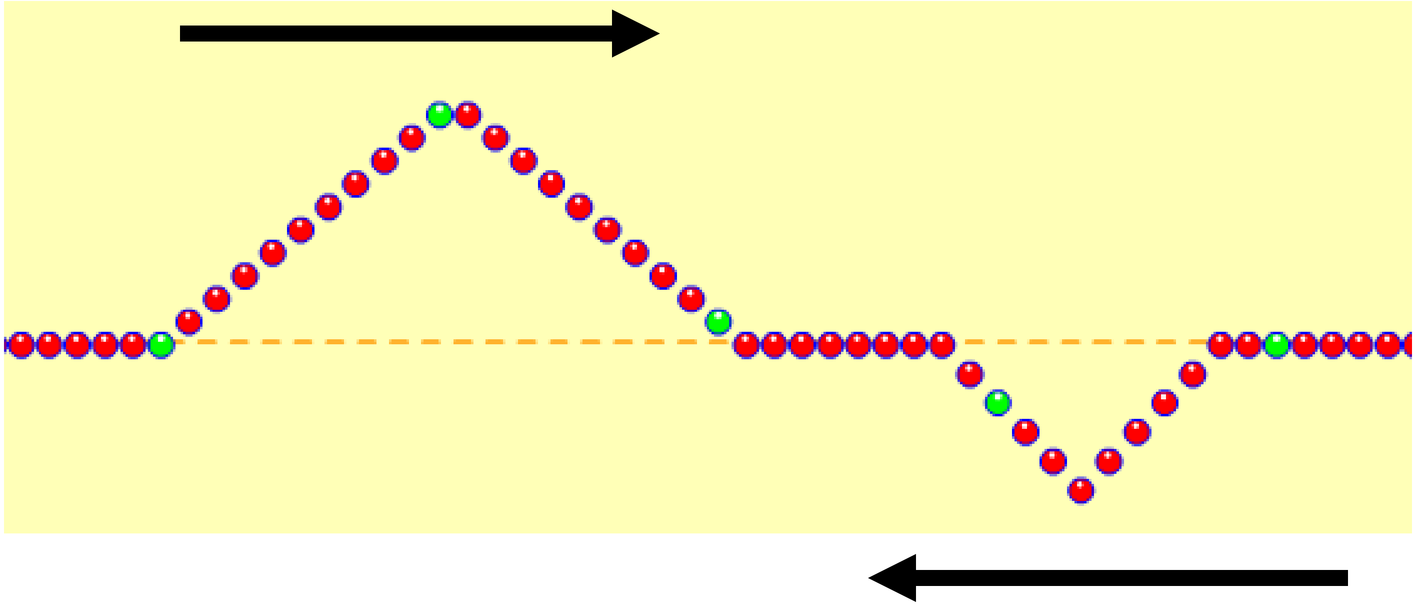
Superposition Principle

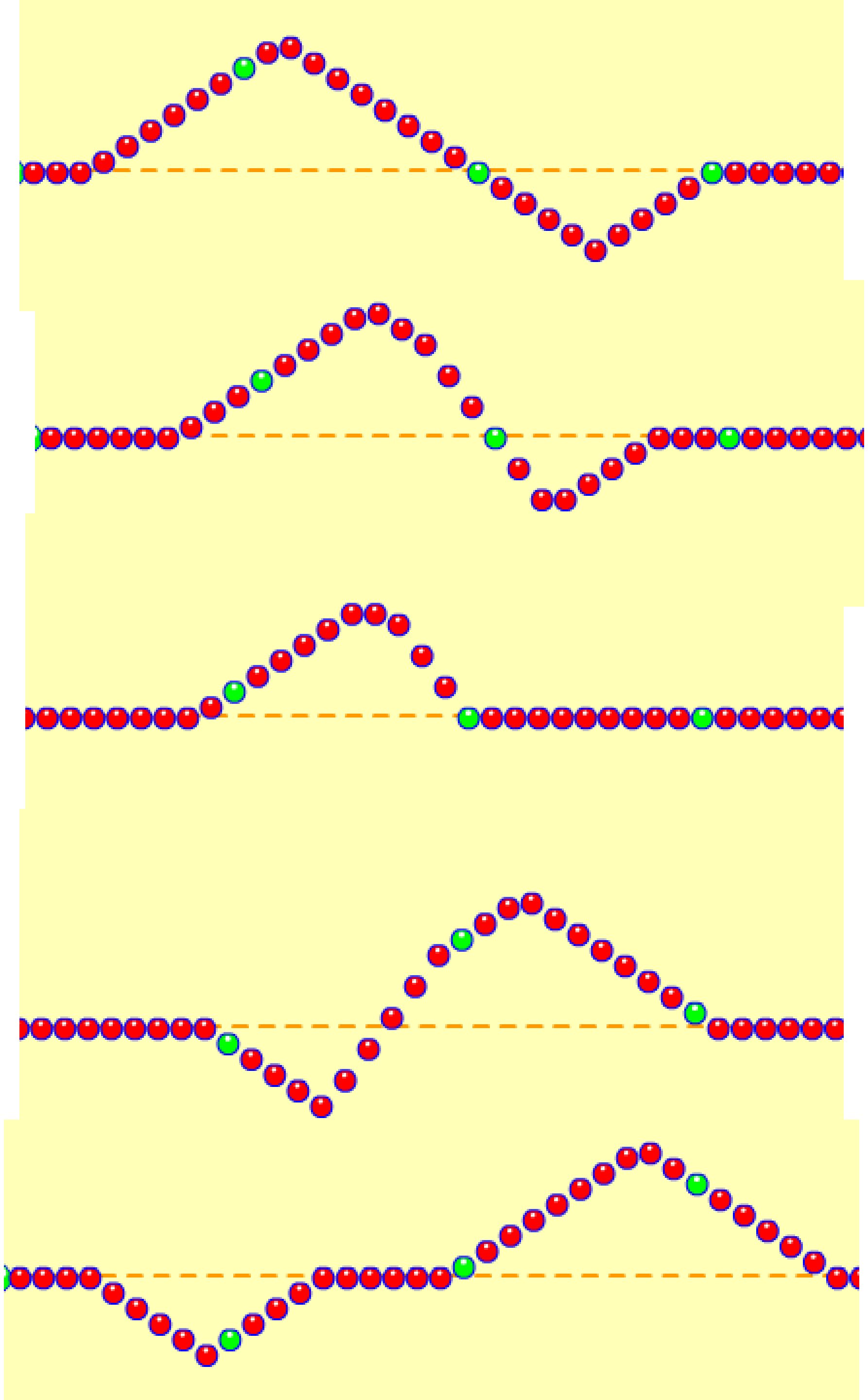
When two or more traveling waves encounter each other while moving through a medium, the resultant wave is found by adding together the displacements of the individual waves point by point.

- Constructive Interference
- Destructive Interference

Transverse, Longitudinal, and Periodic Waves

Sketch what you think the pattern will look like





[Wave on a String]()

Resonance

The natural frequency of an object

Resonance

•Swinging

http://www.youtube.com/watch?v=I4FPK1oKddQ

The swing has a natural frequency that is determined by its length. If the swing is given a small push at the right time in each cycle, its amplitude gradually increases. This is an example of *resonance.* The swing receives a small amount of energy during each push, but provided this amount is larger than the energy lost during each cycle (due to friction and air drag), the *amplitude* of swing increases.

Resonance

- Pasta/raisin demonstration

The frequency an object likes to vibrate at

Resonance

The frequency an object likes to vibrate at

- Wave on a String (A=3, f=50, Damp = 0, Tension = high)

Resonance

The frequency an object likes to vibrate at

- Tall vs. Short Building damage