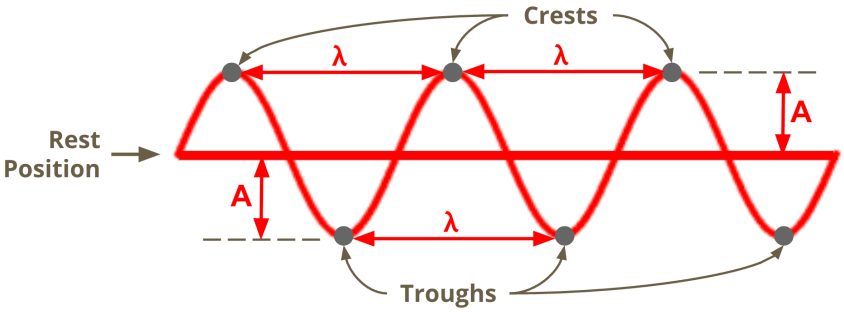
The Anatomy of a Wave
Lesson Notes

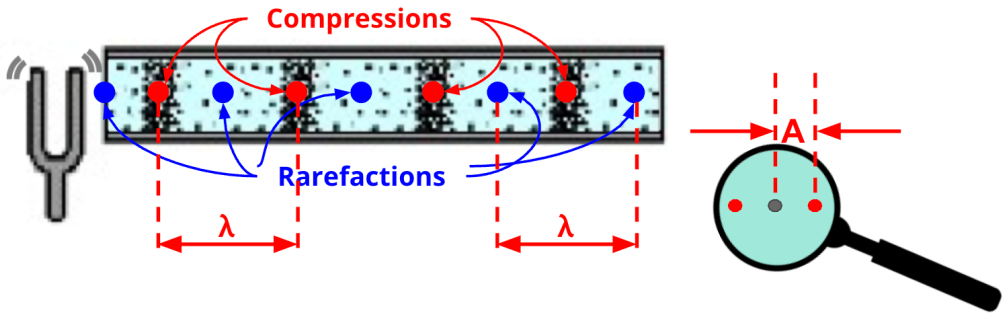
Learning Outcomes
- What is wavelength and how can it be determined from a wave pattern?
- What is amplitude and how can it be determined from a wave pattern?

Transverse Wave: A Snapshot in Time
The back-and-forth vibrations of the medium result in a recognizable pattern that repeats itself across space.



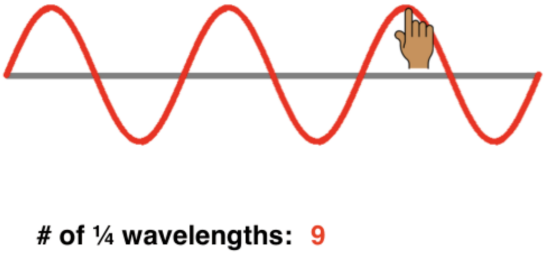
- **Wavelength (λ)**: distance from a crest to an adjacent crest
- **Amplitude (A)**: distance from a rest to a crest

Longitudinal Wave: A Snapshot in Time
Suppose a tuning fork is used to force air inside of a pipe to vibrate back and forth about a fixed position.



- **Wavelength (λ)**: length of the repeating pattern (distance from compression to adjacent compression)
- **Amplitude (A)**: maximum displacement of a particle from rest

Wavelength is …
… the distance from a crest to the next adjacent crest.
… the length of the repeating pattern of a wave.
… the distance from a point on the pattern to the next corresponding point in the next cycle of the pattern.



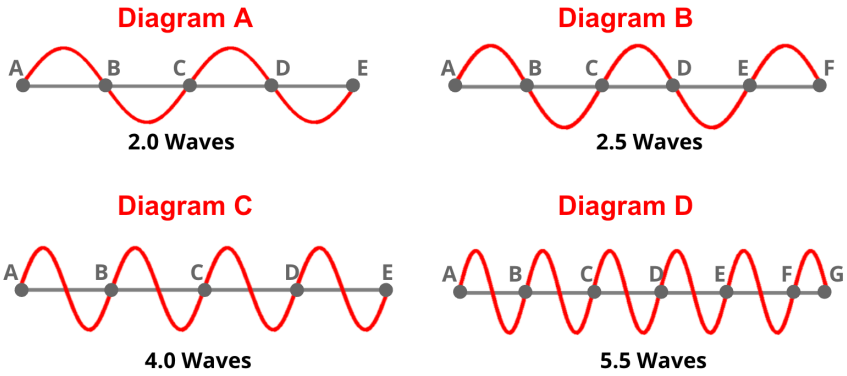
# of ¼ wavelengths: 9

Know this:

crest to rest ⇒ ¼ wave
trough to rest ⇒ ¼ wave
rest to trough ⇒ ¼ wave
rest to crest ⇒ ¼ wave

Counting Waves

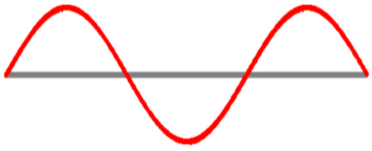
If you know what a wavelength looks like, then you can count the # of wave(lengths) within a given pattern:



Determining λ from a Pattern

If you're given the wave pattern in a rope and the length of the rope, then you can determine the wavelength:

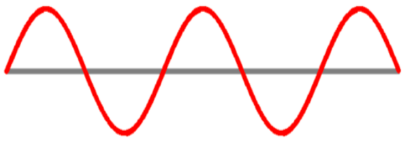
Example 1:



The wave pattern at the left is in a 6.0-m long rope. The wavelength is ...

6.0 m = 1.5 λ ➡ λ = 4.0 m

Example 2:

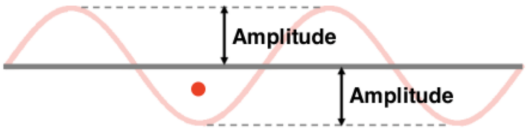


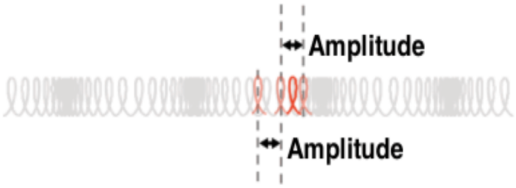
The wave pattern at the left is in a 5.0-m long rope. The wavelength is ...

5.0 m = 2.5 λ ➡ λ = 2.0 m

Amplitude is …

… the distance from rest to crest.
… the height of a wave (measured upward from rest).
… the maximum upward or downward displacement from rest that a particle experiences during any cycle of vibration.





Most common error: measuring twice the distance.

Amplitude-Energy Relationship

- A wave is an energy transport phenomenon.
- The amplitude of motion of the particles of the medium depends on how much energy is put into the wave at the source.

Energy $\propto$ Amplitude^2 $\Rightarrow$ **$E \propto A^2$**

Double A $\Rightarrow$ E increases by x4

Triple A $\Rightarrow$ E increases by x9

Quadruple A $\Rightarrow$ E increases by x16

	A	E
1	1 unit	2 unit
2	2 units	8 units
3	3 units	18 units
4	4 units	32 units