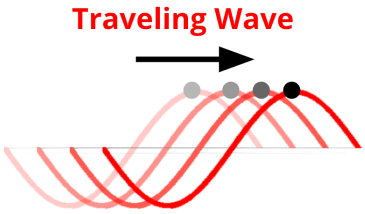
What is a Standing Wave?
Lesson Notes

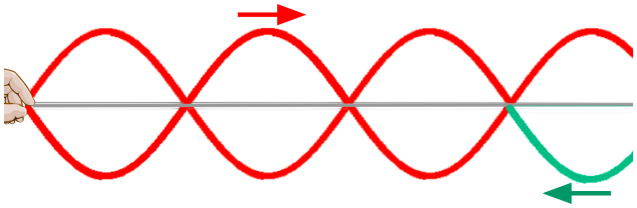
Learning Outcomes
- What is the difference between a standing wave and a traveling wave?
- How and why is a standing wave formed?

Traveling Waves
- A traveling wave is a repeating pattern that is observed to move through a medium in an uninterrupted fashion.
- Traveling waves are observed when a wave is introduced into an unconfined medium (e.g., the ocean).
- The motion remains observable until it meets up with another wave or a boundary with another medium.



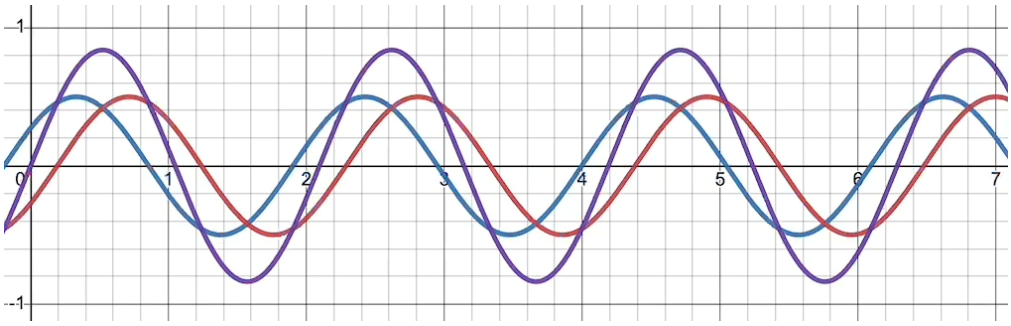
A crest is observed to move through the medium.

Traveling Waves in a Confined Space
Consider a wave that is introduced into a 5-meter-length Slinky.


In a confined medium, the incidence wave reflects. Then 2 waves are traveling through the same medium.

Instead of observing two waves, you would observe the result of the interference of those two waves …
… a seemingly irregular and non-repeating motion. An actual wave pattern is difficult to detect amidst the irregular motions of the individual particles.

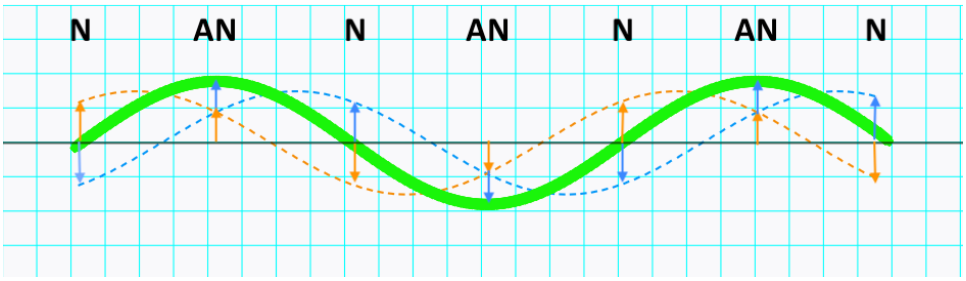
Standing Wave Formation
- When a traveling wave is confined to a small space, a regular and repeating pattern can be observed in the medium if vibrated *at just the right frequency*.
- A **standing wave** is a wave pattern with permanently-positioned points that appear to be standing still.

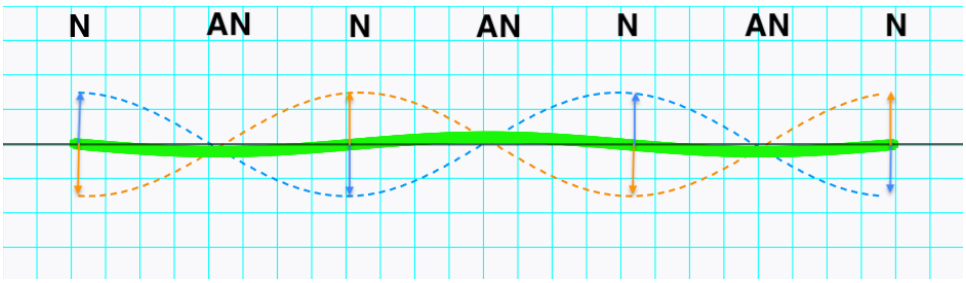


Standing waves consist of …
- **Nodes** (points of **no des**placement)
- **Antinodes** (points with maximum +/- displacement)

It's an Interference Pattern

A standing wave is **NOT** a wave. It is **an interference pattern** resulting from the presence of two traveling waves of the same frequency with different directions of travel within the same medium.





- Destructive interference always occur at the nodal positions.
- Constructive interference always occurs at the antinodes.

"At Just the Right Frequency"

The key to establishing a standing wave within a confined space is to vibrate it *at just the right frequency*.

Harmonic Frequency: One frequency of a set of frequencies that cause a medium to vibrate as a standing wave.

When the introduction of a crest at one end is timed with the reflection of that crest off the opposite end, the two traveling waves will interfere in a manner such that a regular and repeating vibration is observed.