Reflection

Consider a pulse moving through a medium - perhaps through a rope or a slinky. What happens to the pulse when it reaches the end of that medium? The answer depends on whether the medium is fixed in space or free to move at its end.

The **Reflection** of a wave is the transfer of energy back toward the driving source. All reflections will be oriented in either a right side up or upside down direction.

Example:

The orientation of the reflected wave will be caused by the wave entering a new medium with either a free end or a fixed end.

The **Free End** is the end of the material that is free to move around in space or is attached to a less heavy or less dense medium.

When a wave is traveling through the Free End of the medium the pulse reflects off the free end and returns with the same direction of displacement which it had before reflection.

Example:

This behavior of non-inversion will always be observed when the end of the medium is free to move. This behavior of non-inversion is also observed when the medium is connected to another less heavy or less dense medium.

The **Fixed End** is the end of the material that is connected to a fixed, unmovable, position.

When a wave is traveling through the Fixed End of the medium the pulse reflects off the fixed end and returns with the opposite direction of displacement which it had before reflection.

Example:

This behavior of inversion will always be observed when the end of the medium is fixed in position.

In conclusion:

A pulse reaching the end of a medium **does not** become inverted whenever it reflects off a free end.

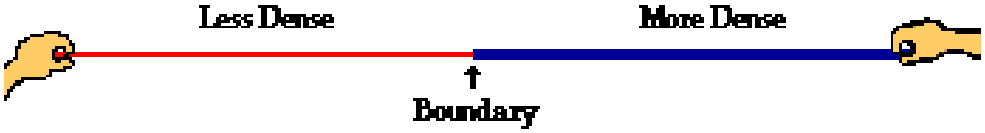
A pulse reaching the end of a medium becomes inverted whenever it either reflects off a fixed end.

Waves Traveling into New Mediums

When waves travel into new mediums the properties of that interaction depend solely on the density of the new medium.

Less Dense to More Dense

Let's consider a thin rope attached to a thick rope, with each rope held at opposite ends by people.



Suppose that a pulse is introduced by the person holding the end of the thin rope. If this is the case, there will be an incident pulse traveling in the less dense medium (the thin rope) towards the boundary with a denser medium (the thick rope).

Upon reaching the boundary, two behaviors will occur.

1. A portion of the energy carried by the incident pulse is reflected and directed in the opposite direction returning towards the left end of the thin rope.

2. A portion of the energy carried by the incident pulse is transmitted into the thick rope oriented in the same direction as the incident pulse.

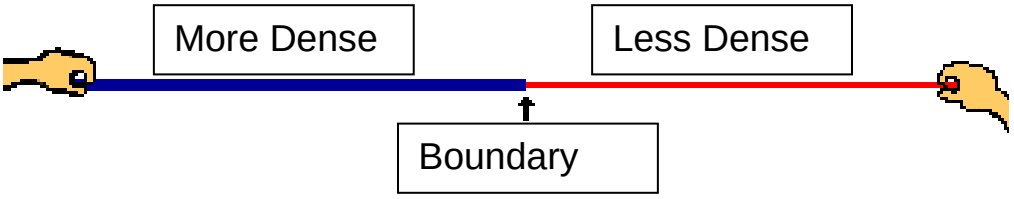
Example:

The disturbance that returns to the left after bouncing off the boundary is known as the **reflected pulse**.

The disturbance that continues moving to the right is known as the **transmitted pulse**.

More Dense to Less Dense

Let's consider a thick rope attached to a thin rope, with the incident pulse originating in the thick rope.



If this is the case, there will be an incident pulse traveling in the denser medium (thick rope) towards the boundary with a less dense medium (thin rope). Once again there will be partial reflection and partial transmission at the boundary.

Upon reaching the boundary, two behaviors will occur.

1. A portion of the energy carried by the incident pulse is reflected and directed in the same direction returning towards the left end of the thick rope.

2. A portion of the energy carried by the incident pulse is transmitted into the thin rope oriented in the same direction as the incident pulse.

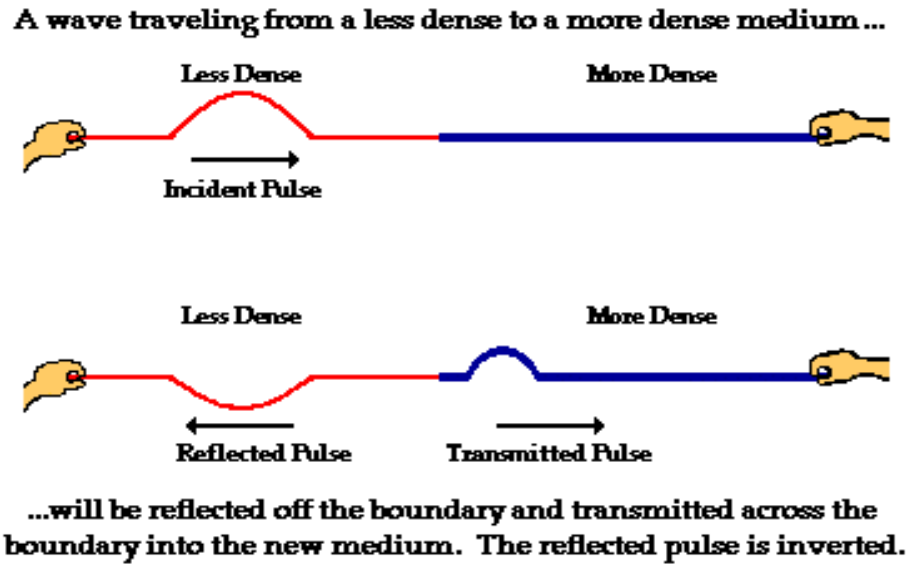
Example:

The disturbance that returns to the left after bouncing off the boundary is known as the **reflected pulse**.

The disturbance that continues moving to the right is known as the **transmitted pulse**.

So in conclusion:
If a wave enters a new medium that is **denser**, than the transmitted pulse will be in the same direction as the original pulse, while the reflected pulse will be in the opposite direction.

The *Before* and *After* snapshots of the two media are shown in the diagram below.



If a wave enters a new medium that is **less dense**, than the transmitted pulse will be in the same direction as the original pulse, while the reflected pulse will be also be in the same direction.

The Before and After snapshots of the two media are shown in the diagram below.