

Model: Superposition of Waves Applied to Waves of Different Frequencies**Act 8.4.1 Interference with Sound Waves II: Beats (~60 min)****Learning Goals:**

- To become familiar with the phenomenon of beats, which occurs when two superposed wave sources have *different* frequencies
- Recognize that this special case of superposition involves an interference condition that is not fixed, but *oscillates in time* between constructive and destructive interference at a given point in space
- Understand that this variation, called beats, occurs with frequency that depends on the frequencies of the two individual wave sources

Model: Superposition of Waves Applied to Vibrating 1-D Media**Act 8.5.1 Standing Waves: Introducing A Useful Model for 1D Vibrations (~30 min)****Learning Goals:**

- Understand the interference pattern, called “standing waves,” of two identical waves traveling in opposite directions

Act 8.5.2 Standing Waves: Applying the Model (~45 min)**Learning Goals:**

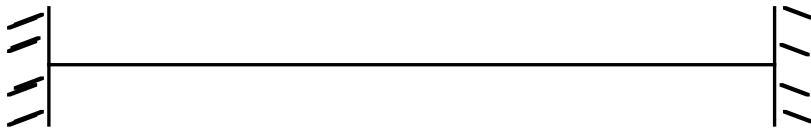
- Recognize how standing wave interference patterns can be used to understand the 1-D modes of vibrations of long stretched “cords”
- Understand the similarities and differences between standing wave patterns with one or two ends fixed to a constant value.
- Become familiar with vibrating air columns in long tubes
- Recognize how the standing wave interference pattern can be used to understand the 1-D modes of vibration of air columns in long tubes

0) If you did not finish Activity 8.5.2, complete it as part of your FNT's.

8.5-1) (Solidification)

A 2 m long string vibrates in the 3rd harmonic ($n=3$) with an amplitude of 2 cm at a frequency of 50 Hz.

a) Sketch the standing wave on the picture below.



b) Determine the speed of the wave. Briefly justify your answer

c) Is there a standing wave if the frequency is changed to 25 Hz? If so, how many antinodes does it have? If not, why not?

8.5-2) (Solidification) The lengths of guitar strings are changed in order to produce different notes. Does shortening guitar strings increase or decrease the frequency of note produced by the string? Explain using the ideas we have developed in this unit.

8.5-3) (Application) A source vibrates an $L = 0.8$ m wire (imagine a guitar "string") at a fixed (but unknown) frequency, generating a standing wave on the string with a certain number of nodes and antinodes. As a result, this string creates a sound wave in air. Do not assume the wave is the fundamental.

a) A Physics 7C student uses her fingers to "pinch" and hold part of the vibrating string. The part of the string away from the vibrating source is stationary. The part of the string connected to the vibrating source still vibrates at the *same* standing wave frequency. Determine the longest possible wavelength (in m) of the string waves that the source could have been producing before it was pinched. Show your work and explain your reasoning.

b) As the sound that the vibrating string goes out into the air, which parameter(s) of the sound wave in air will be the same as the parameters of the vibrating wave on the string and which will be different. Explain.

8.5-4) (Reflect) Critically evaluate your answer for 8.5-2&3) clarity and completeness. Are you using the big ideas we have developed in class?