3.10.1.2: Driven String Simulation

In this simulation a string is driven on one end by an oscillating driver. We can imagine the string as if it were made up of a row of identical oscillating masses, each undergoing simple harmonic motion (just like the row of masses in the transverse wave simulation). Because the string is driven from one end, each successive mass in the row will start later than the one before it (in other words each mass is slightly out of phase with its neighbor). The result is a wave will eventually form on the string.

As we know from the chapter on resonance, if a mass is driven at its natural frequency, its amplitude will increase to a maximum. So the masses that make up the wave on the string will have the largest amplitude only when driven at resonance. When resonance occurs the string has the largest amplitude standing wave on it.

There is one slight complication in this picture, however. There is more than one way for the phases between the masses to occur and still have the masses in resonance. These other resonances occur at multiples of the fundamental resonance frequency and are called harmonics.

Simulation Questions:

1. Start the simulation and wait a few seconds. This is the fundamental (resonance) frequency. What is the period of the wave? (Use the step button and the time to find the period.) What is the frequency of the wave? Is this the same number as the driving frequency?
2. The length of the string is 100 cm. What is the wavelength of the fundamental frequency?
3. Reset the simulation and change the driving frequency to 0.3 Hz. How does the amplitude compare to when the driving frequency is 0.4 Hz?
4. Reset the simulation, set the driving frequency to 0.3 Hz and increase the driving amplitude to 0.09 cm. Is the amplitude of the wave larger than when the driving frequency is 0.4 Hz? Explain.
5. Reset the simulation and change the driving frequency to 0.6 Hz. How does the amplitude compare to when the driving frequency is 0.4 Hz?
6. Now try a driving frequency of 0.8 Hz. How does the amplitude compare to when the driving frequency is 0.3 Hz or 0.6 Hz?
7. This frequency, 0.8 Hz, is the second harmonic; the masses are again in resonance but with different phases. What is the wavelength of the second harmonic?
8. Find the frequencies for the third and fourth harmonics. What are they?
9. What are the wavelengths for the third and fourth harmonics?