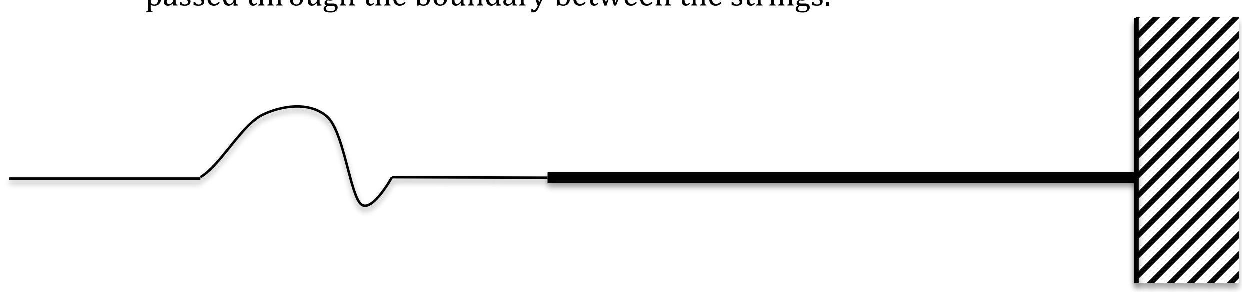
Problem Set #2 SUS PHYS 2, due beginning of class Monday, April 6.

1) Resonance: Do small animals walk slower or faster than large animals of similar build? Imagine a person built just like you, only half the size in every dimension. If you walk at speed v_0, what speed would they walk at? To understand this, please consider that you swing your legs and arms at near natural frequency in order to minimize the input of energy. Have you ever seen a Chihuahua walking? Do you remember how fast the legs swing back and forth? Please model your limbs as pendulums. How will the resonant frequency of these change when the size is cut in half? How will this affect how fast you can walk?

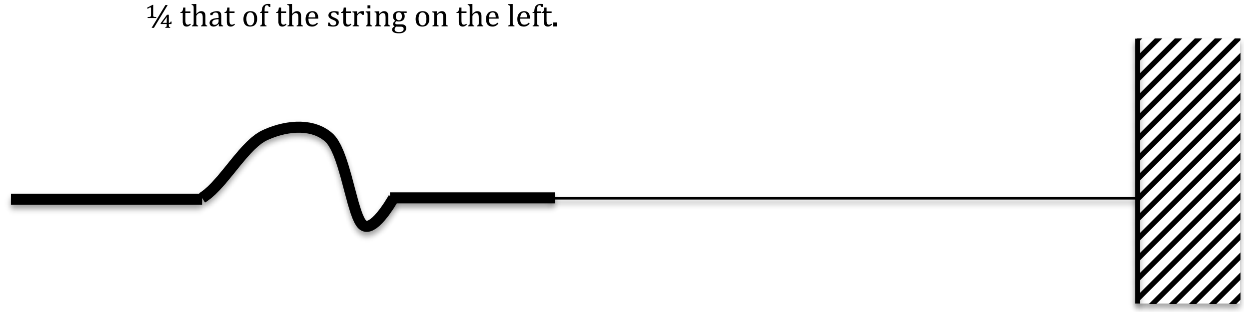
Read how Dogs Pant at a Resonant Frequency to save energy:

2) Find a natural oscillator out in the world. Force it at resonance (in a manner that is ***safe*** and ***nondestructive***).
   a) Calculate the spring constants and the effective mass.
   b) Add mass to the system and predict what the new resonant frequency will be.
   c) Check your results.

3) Below, please see a wave that I made far away from the left with a shake of my hand on a string, bound to a heavier string, bound to a wall. The wave is about one period away from being incident on the boundary with the heavier string, which is four times the linear density of the string on the left.
   a) Please draw the form of the strings about one period *after* the waveform has passed through the boundary between the strings.



   b) Repeat the above question for the waveform on the string shown below where the wave is incident on the boundary with a string that has a mass density that is ¼ that of the string on the left.



4) Please do the last question on MT#1 from 2012 – posted on main website.

5) Address this function of displacement of a string as a function of time and space: $y = Ae^{-G}$, *where* $A = 0.2$ *m, and* $G = (kx-\omega t+\phi)^2$, where $k = 2/m$, $\omega = 4/s$, and $\phi = -0.5$.

a) Please graph the function for t = 0 and again for t = 0.5 s. Please graph them directly under each other so that we can see how they are moving.
b) In the first drawing, please indicate the direction of the speed of the wave.
c) *How would you calculate the speed of the string? Do it if you like.
d) In the second drawing, please indicate the direction of the acceleration of the wave. * How would you calculate the acceleration of the string? Do it if you like.

6) Address this function of displacement of a string as a function of time and space: $y = A^* \sin(kx+\omega t+\phi)$, where $A = 0.2$ *m*, $k = 4\pi/m$, $\omega = \pi/s$, and $\phi = -\pi/4$.

a) Please find the period, *T*, the frequency, *f*, and the speed of the wave *v*, Please graph the function for t = 0 and again for t = 0.5 s. Please graph them directly under each other so that we can see how they are moving.
b) In the first drawing, please indicate the direction of the speed of the string.
c) *How would you calculate the speed of the string? Do it if you like.
d) In the second drawing, please indicate the direction of the acceleration of the string.
e) *How would you calculate the acceleration of the string? Do it if you like.
f) How would the displacement of the string at the origin look as a function of time? Please make a graph of this for two cycles, starting from t = 0 s.