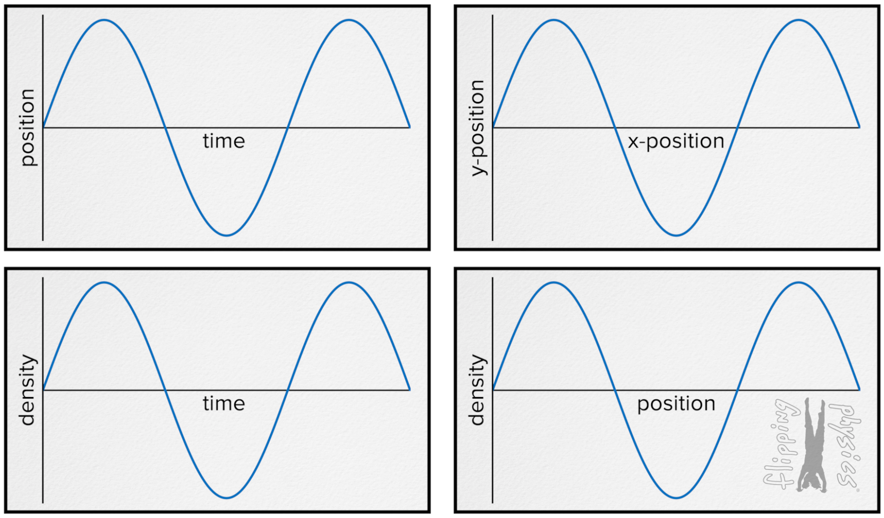
Flipping Physics Lecture Notes:

Wave Graphs - Longitudinal and Transverse - Wavelength and Period
https://www.flippingphysics.com/wave-graphs.html

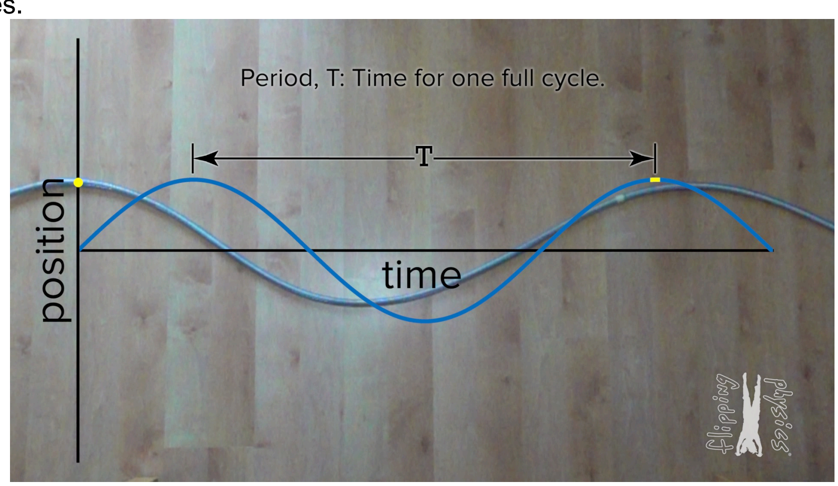
These are four graphs of mechanical waves which, at first, might look identical, however, it is very important that you understand the differences.



The key difference here is what is on the y and x axes. On the y-axis we have either position or density. On the x-axis we have either time or position. Let's start with understanding the position as a function of time graph. If we have a mass-spring system moving in simple harmonic motion, this could describe the position of a mass-spring system as a function of time. This could also describe the movement of a mechanical wave as a function of time. More specifically, this describes a transverse wave. A transverse wave is where the direction of wave propagation is perpendicular to the direction of the disturbance of the medium. This graph represents the position of a specific point on the transverse wave as a function of time.

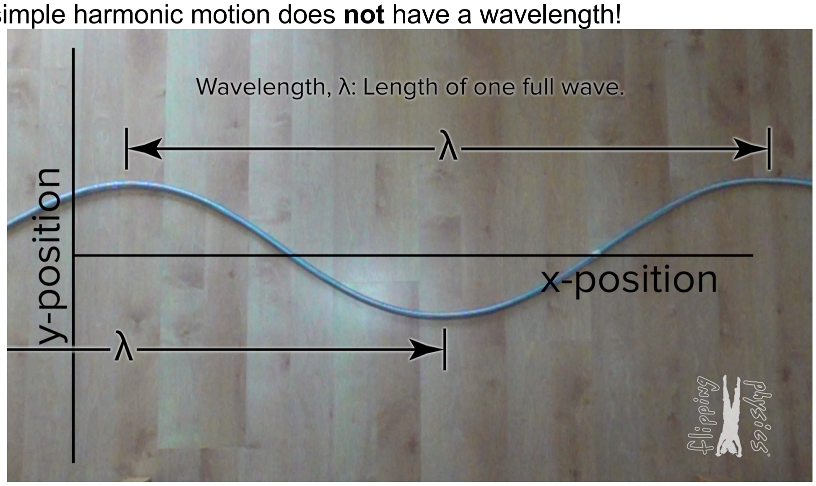
Let's change the x-axis now to position in the x-direction. Notice this graph can no longer describe the motion of a mass-spring system moving in simple harmonic motion, because a mass-spring system only moves in one dimension. However, this graph can describe the motion of a mechanical wave. This graph simply describes the location of all of the particles of a mechanical wave at one specific moment in time.

Now what about the measurement which extends between successive crests or successive troughs? Going back to the graph of position as a function of time, that measures the Period, T, or the time it takes for the system to oscillate through one full cycle. This is true for both simple harmonic motion and mechanical waves.



However, what is the measurement between successive crests for a graph of y-position as a function of x-position? This is called Wavelength:

- Wavelength: The length of one complete wave cycle. Measured from crest to successive crest, trough to successive trough. In other words, measured from one point on the wave to the next corresponding point on the wave which is going in the same direction.
- Wavelength: The distance travelled by a wave during one period.
- The symbol for wavelength is λ, the lowercase Greek letter lambda.
- Notice because simple harmonic motion does not have a graph of y-position as a function of x-position, simple harmonic motion does **not** have a wavelength!



Let's now change the graph to density as a function of time. How is this different? This describes a mechanical wave and not simple harmonic motion, but how? This describes a longitudinal wave. A longitudinal wave is where the direction of wave propagation is parallel to the direction of the disturbance of the medium. In other words, a crest on the graph represents a location of higher density in a longitudinal wave; a location of compression. A trough on the graph represents a location of lower density in a longitudinal wave; a location of rarefaction. This represents the density of a specific location of the longitudinal wave as a function of time.

If we talk about the last graph which is density as a function of position, again this describes a mechanical, longitudinal wave, just the density of the whole wave at one specific point in time. The terms period and wavelength are still applicable for the longitudinal wave. Period for the density as a function of time graph. And wavelength for the density as a function of position graph.

Remember, the only one of these graphs which describes an object moving in simple harmonic motion is the first one, the position as a function of time graph.