# Waves Intro PHeT Activity

**Choose** the “Water” option

**Find** all the following settings/switches and become familiar with the operation of the simulation:

* Water on/off
* Continuous Wave (CW) or Pulse
* Top/Side Views
* Pause and Playback Speeds
* Ruler
* Stopwatch
* Dual Water-level Probe (DWL)
* Frequency/Amplitude Sliders
* Graph Option

## Write an Equation for the Wave

1. Set the water to produce a CW.
2. Set the frequency slider in the middle, then using the stopwatch feature, determine the **period** of the waves.
3. From the period value, calculate both the **frequency** and **angular frequency** of the waves.
4. Using the ruler feature, determine the **wavelength** of the wave. Convert your measurement to meters.
5. From the wavelength value, calculate the **wave number**.
6. Using the ruler feature, determine the **amplitude** of the wave.
7. Write down an equation for the wave. (Let the phase term, φ, be zero.)

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| Period, T (s) | Frequency, f (Hz) | Angular Frequency, ω (rad/s) | Wavelength, λ (m) | Wave number, k (rad/m-1) | Amplitude, A (m) | Phase Velocity, vp (m/s) |
|  |  |  |  |  |  |  |
| Equation: |  |

Determine the frequency, wavelength and phase velocity when you change the slider to “min” and then “max.”

|  |  |  |
| --- | --- | --- |
|  | “min” | “max” |
| f = |  |  |
| λ = |  |  |
| vp = |  |  |

Knowing the angular frequency and the amplitude, what is the maximum speed of the surface of the water as it moves up and down?

vmax =

**Practice**: For the following wave equations, determine the values for the different variables.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | ω | f | T | k | λ | A | vp |
| $$y\_{1}\left(x,t\right)=10 sin⁡(5x-3t)$$ |  |  |  |  |  |  |  |
| $$y\_{2}\left(x,t\right)=.5 sin⁡(2x+6t)$$ |  |  |  |  |  |  |  |
| $$y\_{3}\left(x,t\right)=4 sin⁡(x-8t)$$ |  |  |  |  |  |  |  |

# Phase Fun

Set the frequency to be somewhere near the middle, then determine the value of the frequency and the wavelength. (Keep that frequency setting constant for the rest of the activity.)

f = Hz, ω = rad/s, λ = m, k = rad/m

1. Pause the simulation and retrieve the DWS.
2. Put the sensors at the locations of peaks – but not the same peak.
3. Unpause the simulation and describe what the sensors are recording.

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1. Measure the distance between the two sensors, and calculate:

$$k ∆x= $$

$$∆x/λ=$$

1. Pause the simulation.
2. Place one sensor at a peak and the other at a trough.
3. Unpause the simulation and describe what the sensors are recording.

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|  |

1. Measure the distance between the two sensors and calculate:

$$k ∆x= $$

$$∆x/λ=$$

1. Verify that every time $\frac{∆x}{λ}=n$ that the sensor outputs are synchronized. (n=1, 2, 3…)
2. Verify that every time $\frac{∆x}{λ}=n+1/2$ that the sensor outputs are completely out-of-phase.