Wavelength-Frequency-Speed

Purpose: To determine the relationship between wavelength, frequency, and the speed of a wave.

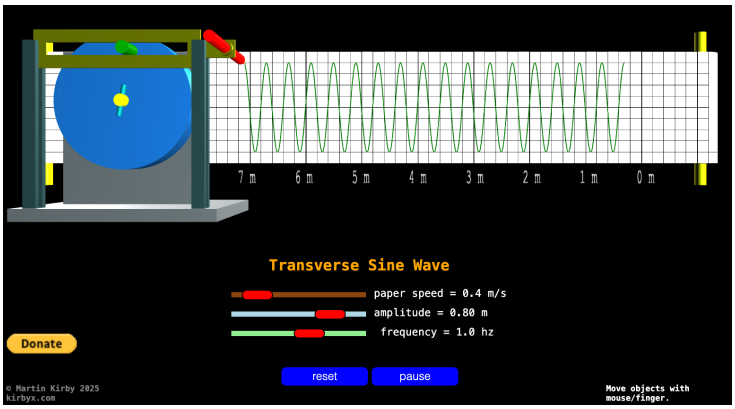
Getting Ready: Navigate to the **Transverse Sine Wave Maker** simulation found in the **Physics Interactives** section at **The Physics Classroom**.

https://www.physicsclassroom.com/Physics-Interactives/Waves-and-Sound/Transverse-Sine-Wave-Maker

Navigation:

www.physicsclassroom.com => Physics Interactives => Waves and Soound => Transverse Sine Wave Maker

Getting Acquainted/Play:

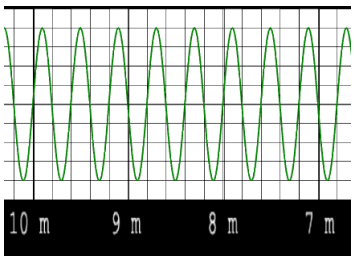


This interactive models the formation of a transverse wave. A rotating wheel has an attached marker that oscillates up and down and draws on a sheet of paper. The paper is attached to two spools which can rotate to move the paper as the marker draws on it. The **paper speed**, the **amplitude** (of the marker's motion), and the **frequency** (of the marker's motion) can be modified. Take some time to get acquainted with the interface. Drag the sliders, tap on the reset/pause buttons. Observe how it works.

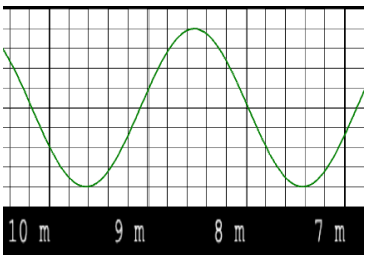
Once you're ready, reload the page and proceed to the two-part activity below.

Part 1: Qualitative Observations

1. You will need to be able to recognize the wavelength of a wave. Wavelength (λ) is the length of the repeating pattern in a wave display. It is often equated with the distance between two adjacent crests. Before proceeding, make sure you understand the distinction between short λ and long λ.



Short or Small λ



Long or Large λ

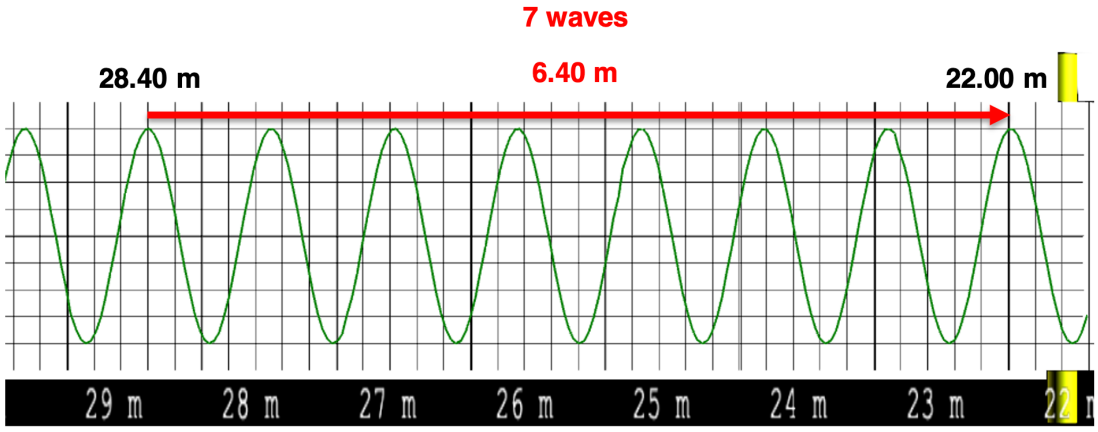
2. Make some changes in the speed (while keeping other variables constant). What affect does increasing speed have on wavelength (λ)?

3. Make some changes in the frequency (while keeping other variables constant). What affect does increasing frequency have on wavelength (λ)?

4. Make some changes in the amplitude (while keeping other variables constant). What affect does increasing amplitude have on wavelength (λ)?

Part 2: Quantitative Analysis

5. In Part 2, you will be more quantitative and collect some data. You will need to be able to measure wavelength. You can determine the distance between two adjacent crests OR you can determine the distance of X waves and divide the distance by X. Either method will provide a value for λ. The second method provides a more accurate value.



λ = Distance / #of Waves = (6.40 m / 7) = 0.914 m

6. Set some paper speed greater than 1.0 m/s. Record above Table 1.

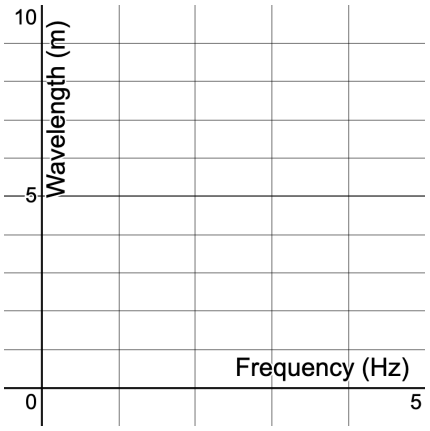
7. For several different frequency (f) values, make measurements off the paper to determine the wavelength. Pause-Measure-Record. Use a range of frequencies and select ones that tend to be simple whole number multiples of each other. Record in Table 1.

Table 1: Effect of f on λ

Speed = _____ m/s (≥ 1.0 m/s)

Trial	f (Hz)	λ (m)
1		
2		
3		
4		
5		

8. Open a Graphing Tool (or use our Desmos file - https://www.desmos.com/calculator/528tlomstv). Enter values from the table and determine a best-fit equation for the data. Sketch the shape of the graph in the space at the right. Write the equation below using symbols f and λ.

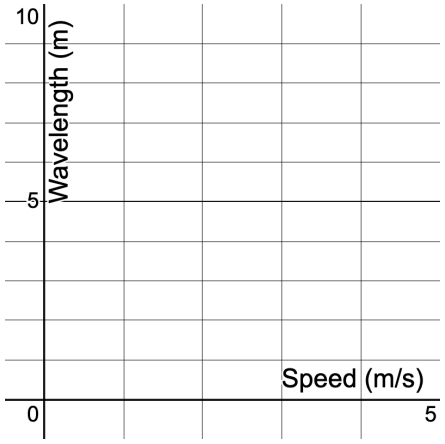


9. The relationship between f and λ is a(n) _____ (linear, quadratic, inverse, non-) relationship.

10. The constant of proportionality in the equation above represents the _____.

11. Set the frequency to 2.0 Hz.
12. For several different frequency (v) values, make measurements off the paper to determine the wavelength. Record each value. Use a range of speeds and select ones that tend to be simple whole number multiples of each other. Record in Table 1.
13. Open a Graphing Tool (or use our Desmos file - https://www.desmos.com/calculator/xyxk07wdzv - different than the earlier one). Enter values from the table and determine a best-fit equation for the data. Sketch the shape of the graph in the space at the right. Write the equation below using symbols v and λ.

Table 1: Effect of v on λ Frequency = 2.0 Hz		
Trial	**v (m/s)**	**λ (m)**
1		
2		
3		
4		
5		



14. The relationship between v and λ is a(n) _____ (linear, quadratic, inverse, non-) relationship.
15. The constant of proportionality in the equation above represents the _____.

Conclusion

What is the equation that relates wavelength (λ), frequency (f), and speed?

Make a claim, writing your equation using symbol form. Then (and most importantly) present evidence and use reasoning based on the findings of this activity to support the claim you are making.