

### Standing Wave Mathematics

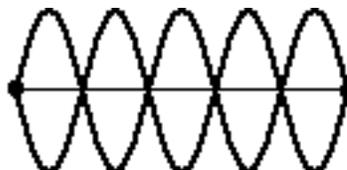
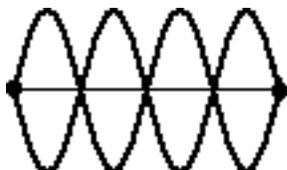
Read from **Lesson 4** of the **Waves** chapter at **The Physics Classroom**:

- <http://www.physicsclassroom.com/Class/waves/u1014a.html>
- <http://www.physicsclassroom.com/Class/waves/u1014b.html>
- <http://www.physicsclassroom.com/Class/waves/u1014c.html>
- <http://www.physicsclassroom.com/Class/waves/u1014d.html>
- <http://www.physicsclassroom.com/Class/waves/u1014e.html>

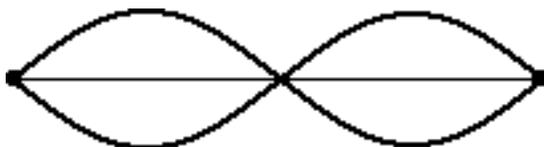
**MOP Connection:** Waves: sublevels 7 and 8

A standing wave pattern results in a string, rope or snakey as a result of the interaction between the waves introduced on one end with the reflection of the waves returning from the opposite end. At certain frequencies, a pattern will be established within the medium in which there are positions that always appear to be stationary. Midway between each of these stationary positions are positions which are undergoing rapid motion between a maximum positive and maximum negative displacement from their resting position.

1. The positions along the medium that appear to be stationary are known as \_\_\_\_\_. They are points of **no displacement**.
2. The positions along the medium that are undergoing rapid motion between a maximum positive and maximum negative displacement are known as \_\_\_\_\_. They are the **opposite of the points of no displacement**.
3. Label the nodes (N) and antinodes (AN) in the following standing wave patterns.



4. In each of the two diagrams of standing wave patterns, count the number of nodes and antinodes.



5. Each node is separated by the adjacent node by a distance that is equal to \_\_\_\_\_ wavelength.
6. Draw the standing wave pattern that would result on the string below if the string vibrated with the first, second, and third harmonic wave patterns. State the relationship between length and wavelength for each of the three patterns.

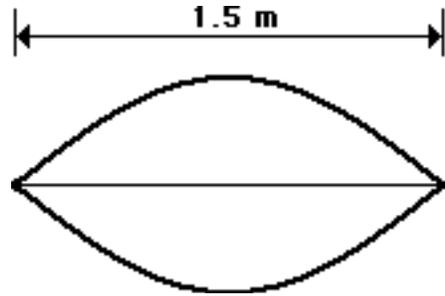
<b>1st Harmonic</b>	<b>2nd Harmonic</b>	<b>3rd Harmonic</b>
$L = \text{_____} \lambda$	$L = \text{_____} \lambda$	$L = \text{_____} \lambda$

7. Suppose that the string in the above diagram is 1.2 meters long. Determine the wavelength of the waves shown in each of these three patterns.

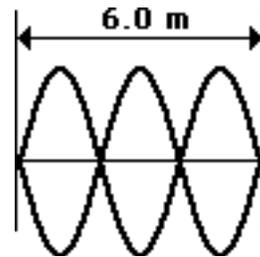
1st Harmonic                      2nd Harmonic                      3rd Harmonic

## Wave Basics

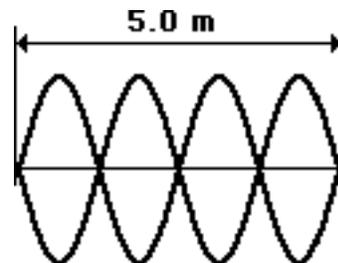
8. The string at the right is 1.5 meters long and is vibrating as the first harmonic. The string vibrates up and down with 33 cycles in 10.0 seconds. Determine the frequency, period, wavelength and speed for this wave. **PSAYW**



9. The string at the right is 6.0 meters long and is vibrating as the third harmonic. The string vibrates up and down with 45 cycles in 10.0 seconds. Determine the frequency, period, wavelength and speed for this wave. **PSAYW**



10. The string at the right is 5.0 meters long and is vibrating as the fourth harmonic. The string vibrates up and down with 48 cycles in 20.0 seconds. Determine the frequency, period, wavelength and speed for this wave. **PSAYW**



11. The string at the right is 8.2 meters long and is vibrating as the fifth harmonic. The string vibrates up and down with 21 cycles in 5.0 seconds. Determine the frequency, period, wavelength and speed for this wave. **PSAYW**

