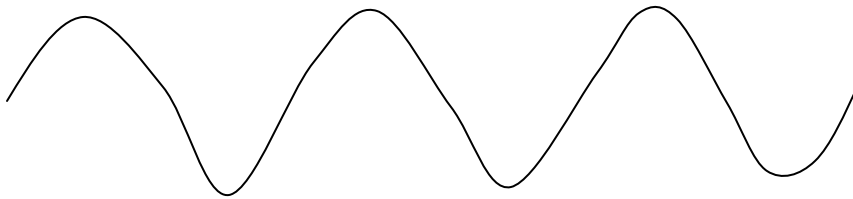


Wave and MOSAIC Basics
Student Worksheet

Answer the following questions during or after your study of the basics of waves.

1. Where is the mesosphere? How does its temperature compare to the stratosphere and troposphere?
2. What happens to the temperature as one goes to higher altitudes in the mesosphere?
3. How are waves related to simple harmonic motion?
4. How are transverse and longitudinal waves different?
5. On the diagram below, label the amplitude, wavelength, crest, and trough of the wave. What type of wave is pictured?



6. Sitting at one point on a slinky, an ant counts and notices that 3 waves pass by him every second.
 - a. What is the frequency of this wave?
 - b. What is the period of this wave?
 - c. If the ant is able to judge the distance between two compressions of the slinky to be 0.75 m, what is the speed of the wave along the slinky?
 - d. If the source of the wave now speeds up so that the ant experiences 5 waves each second, what is the speed of the wave along the slinky?
 - e. What will be the distance between compressions now that the source frequency has increased?
7. What is the difference between mechanical and electromagnetic waves?
8. In many science fiction movies, there are big, loud battles between enemy spaceships in space. What is wrong, from a physics perspective, with the depiction of these battles?

9. A particular wave is transverse. Is it electromagnetic or mechanical? How do you know?
10. A different wave is longitudinal. Is it electromagnetic or mechanical? How do you know?

Wave and MOSAIC Basics WS

Teacher Notes

This worksheet is intended to accompany the Wave and MOSAIC Basics PowerPoint (Wave Basics.pptx) created as part of Haystack Observatory's RET project on Physics and MOSAIC. The PowerPoint can be used as an in-class presentation, but also could be re-envisioned as a Webquest-type activity of self-directed learning.

1. Where is the mesosphere? How does its temperature compare to the stratosphere and troposphere?

The mesosphere is the layer of the atmosphere above the troposphere and stratosphere, but below the thermosphere. It is colder than the lowest parts of the troposphere, and its temperature varies, from the same range as the stratosphere and upper troposphere to colder than it.

2. What happens to the temperature as one goes to higher altitudes in the mesosphere?

As altitude increases, the temperature of the mesosphere **decreases**.

3. How are waves related to simple harmonic motion?

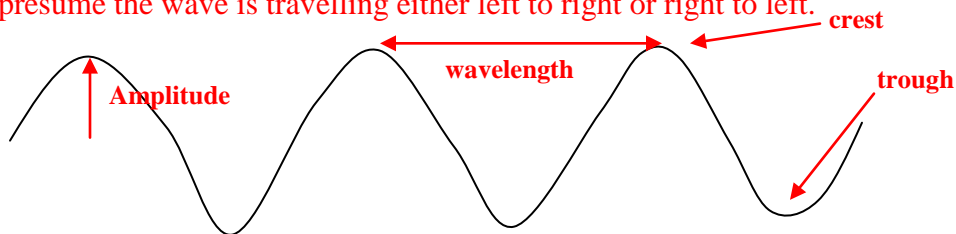
The oscillations that produce the propagation of a wave are frequently simple harmonic. For mechanical waves, energy is transferred by the transmission of energy from one adjacent simple harmonic oscillator to the next. For electromagnetic waves, the oscillations of the fields are approximately simple harmonic.

4. How are transverse and longitudinal waves different?

Transverse waves consist of oscillations perpendicular the direction that the wave is traveling. Longitudinal waves consist of oscillations parallel to the direction that the wave is travelling.

5. On the diagram below, label the amplitude, wavelength, crest, and trough of the wave. What type of wave is pictured?

This is a transverse wave, since the particles have oscillated up and down and we presume the wave is travelling either left to right or right to left.



6. Sitting at one point on a slinky, an ant counts and notices that 3 waves pass by him every second.

- a. What is the frequency of this wave?

3 Hz

- b. What is the period of this wave?

$T = 1/f = 1/3 = 0.33 \text{ s}$

- c. If the ant is able to judge the distance between two compressions of the slinky to be 0.75 m, what is the speed of the wave along the slinky?
 $v = \lambda f = 0.75 * 3 = \mathbf{2.25 \text{ m/s}}$
 - d. If the source of the wave now speeds up so that the ant experiences 5 waves each second, what is the speed of the wave along the slinky?
 v is constant for a given medium, so it is still $\mathbf{2.25 \text{ m/s}}$.
 - e. What will be the distance between compressions now that the source frequency has increased?
 $v = \lambda f$; so $\lambda = v / f = 2.25 / 5 = \mathbf{0.45 \text{ m}}$.
7. What is the difference between mechanical and electromagnetic waves?
 Electromagnetic waves can propagate through a vacuum and are always transverse.
 Mechanical waves require a medium and can be transverse or longitudinal.
 8. In many science fiction movies, there are big, loud battles between enemy spaceships in space. What is wrong, from a physics perspective, with the depiction of these battles?
 In space, sound cannot travel, since sound is a mechanical wave and space is very nearly a vacuum. Thus, the explosions in space should not produce a sound; they would be totally silent.
 9. A particular wave is transverse. Is it electromagnetic or mechanical? How do you know?
 It could be either electromagnetic or mechanical, as both types can be transverse.
 10. A different wave is longitudinal. Is it electromagnetic or mechanical? How do you know?
 It must be mechanical, since all electromagnetic waves are transverse.