Name_____ Date_____ Period____

Waves

Definition:

Mechanical Waves

Definition:

Matter Used Called:

Types of Mediums:

Transverse Wave

Definition:

Examples:

Parts:

Image:

Compressional (Longitudinal) Wave

Definition:

Examples:

Parts:

Image:

Electromagnetic Waves

Definition:

Examples:

Parts:

Image:

The Sounds Of Summer

Lesson Plan

Academic Subjects: General science, physics

Academic Topics: Velocity, speed of sound, speed of light

Background: Everybody has experienced the time delay between a bolt of lightning and the boom of thunder. A first interpretation may be that they are related events which occur one after the other. A simpler explanation is that they signal the same event, but the message carried by the sound arrives later than the message carried by the light.

Discussion: The speed of sound can be observed quite simply if there is a big enough field. If one person were to clap their hands over their head, the second distant person would see the hands meet and then have to wait for the sound to arrive. Measuring the separation distance and the time delay between seeing the hands meet and hearing the sound would provide a good measurement for the speed of sound.

$$\text{velocity} = \frac{\text{distance}}{\text{time}} \qquad v = \frac{d}{t}$$

This measurement would yield a value of approximately 340 m/s. It will vary depending on the temperature of the air.

The speed of light is much more difficult to measure. The speed of light is 300,000,000 m/s or 186,000 miles/second. When you turn on a flashlight, the light reaches the far wall which may be 10 meters away in much less than a millionth of a second. We cannot possibly observe that with our senses.

The way in which the speed of light can be measured is to either increase the distance the light travels, improve the accuracy of our clocks, or both. Danish astronomer Ole Roemer measured the time delay for light traveling from Jupiter to the Earth. Albert Michelson was able to build rotating mirrors to get a precise measurement of the time.

Communications satellites must detect the radio signals (which travel at the speed of light) and send them back down to the Earth. Our communications satellite requiring a period of 24 hours is situated at 22,000 miles above the Earth. Since the radio signals from the Earth to the satellite must travel 44,000 miles round trip, there is a delay between the sending and receiving of the signal even though the signal travels at the enormous speed of light.

Extending the Lesson:

• Try to measure the speed of sound in an open field by clapping hands and measuring the time delay in seeing the hands clap and hearing the sound at a long distance away.

• Try to measure the speed of light by listening to a conversation between astronauts on the Moon and Mission Control on Earth.

The Sounds Of Summer

Activity Sheet

1. *The speed of sound is approximately 340 m/s. How long will it take for the sound to travel from the batter to a spectator who is seated 30 meters away? How long will it take if the spectator is 150 meters away?*

2. *The speed of light is approximately 300,000,000 m/s. How long will it take for the light to travel from the batter to a spectator who is seated 30 meters away? How long will it take if the spectator is 150 meters away?*

3. *A storm is 10 miles (16,000 meters) away. If the light from the lightning travels at 300,000,000 m/s and the sound from the thunder travels at 340 m/s, calculate the delay between seeing the lightning and hearing the thunder. Can you come up with a general rule which tells you the distance to the storm if you measure the time delay?*