Post-Conference Activities

Waves

Teacher Sheet(s)

Objective: Students will identify the components of a radio wave and create waves in different frequencies.

Level: 9-12
Subjects(s): Physical Science, Technology
Prep Time: 10-30 minutes
Duration: 40 minutes
Materials Category: General Classroom

National Education Standards
Science: Unifying Concepts, Physical Science
Technology (ITEA): 2, 3, 17

Materials:
(Per group)

- Glass, plastic, or metal pan
- Watero Eye dropper
- One Slinky per group of two; or
- One short rope or jump rope
- Data collection sheet

Pre-Lesson Instructions:
None

Background Information:
Transverse waves cause the particles of a medium to move perpendicular to the direction of the wave. In a Slinky, the spring is displaced up and down at right angles to the motion of the wave. Waves in piano and guitar strings are examples of transverse waves. A longitudinal wave causes the particles of a medium to move parallel to the direction of the wave. The displacement of the spring is parallel to the motion of the wave. A sound wave is an example of a longitudinal wave. Fluids-either liquids or gases-transmit only longitudinal waves.

Guidelines:

1. Read the article, "Hamming It Up On ISS." Discuss the use of amateur radios and how they are being used to communicate to astronauts.

2. After dropping water in the pan, guide students to observe the wave that has been created as it moves outward along the surface of the water in expanding circles.

3. Explain how the Slinky represents waves and how students might look at different frequencies. Guide students to understand that faster movement corresponds to higher frequency and shorter wavelengths.

4. Show a chart of the electromagnetic spectrum. Discuss the different forms of waves contained in the spectrum. Discuss the size of the wavelengths and the energy of each type of wave.

Discussion/Wrap-up:
None

Extensions:

- Have interested students contact a local ham radio operator or local amateur radio club to learn more.
- Invite a ham radio operator to speak to your class and provide a demonstration.

Waves

Student Sheet(s)

Objective:
Students will identify the components of a radio wave and create waves in different frequencies.

Materials:
- Glass, plastic, or metal pan
- Water
- Eye dropper
- One Slinky per group of two; or
- One short rope or jump rope
- Data collection sheet

Background Information:
When Heinrich Hertz first demonstrated radio waves in 1886, he found the source of all waves was something that vibrates. Radio waves vibrate at the lowest frequency and have the longest wavelengths on the electromagnetic spectrum. Radio waves are electromagnetic waves that originate from the vibration of electrons. Sound waves are not electromagnetic waves, but a mechanical vibration of matter. So even though we hear a radio by means of sound waves, radio waves and sound waves are not the same.

Electromagnetic waves are classified according to their frequency. Waves all move, or vibrate, at the same speed ("c" for constant), but differ in their frequency. The frequency is how often a vibration occurs. This unit of frequency is called a hertz (Hz). Thus, the speed of a given wave is measured in meters per second.

A wavelength is the distance, measured in meters; a wave travels through space in a single cycle. It can be measured from any point along the wave as long as it is consistently measured from the same point. The speed of the wave is equal to the frequency times the wavelength. The amplitude of a wave is the maximum displacement on either side of the midpoint of a wave. The midpoint is the point at which the wave is at rest.

A specific radio frequency is assigned to amateur radio operators when they are transmitting to space. All amateur radio operators, this includes those who operate for Space Amateur Radio Experiments (SAREX) missions, use a small portion of the frequency bands on the electromagnetic spectrum. Any amateur station that is located more than 50km above Earth's surface is defined by the Federal Communications Commission (FCC) as a space station. Amateur satellites, the Space Shuttle orbiters, the Russian MIR Space Station, and the International Space Station all fall under this category.

Procedure:

1. Predict what will happen when a drop of water is dropped into a pan of water, where the surface of the water is flat. Write predication on the data collection sheet.

2. Drop water from an eyedropper into the center of the pan. Write down your observations. What shapes were the waves that were created? How did the waves move? Were the circles evenly spaced?

3. Draw a picture of the wave. Label the crest, trough, amplitude, midpoint, and wavelength.

4. Stretch the Slinky to about 1 meter on the floor (not carpet) or tabletop. (Do not overstretch.)

5. One student holds one end of the Slinky still.

6. Another student will move the other end slowly back and forth. Start slowly then increase the rate at which the Slinky is moved back and forth.

7. This time you and your lab partner will create equal-sized pulses at the same time from opposite ends of the Slinky. It may require some practice to get your timing synchronized. Try it both ways-that is, with pulses on the same side and then with the pulses on opposite sides of the line of propagation. Pay special attention to what happens as the pulses overlap. Record your observations.

Data Collection Sheet

Name _____

Group Names _____

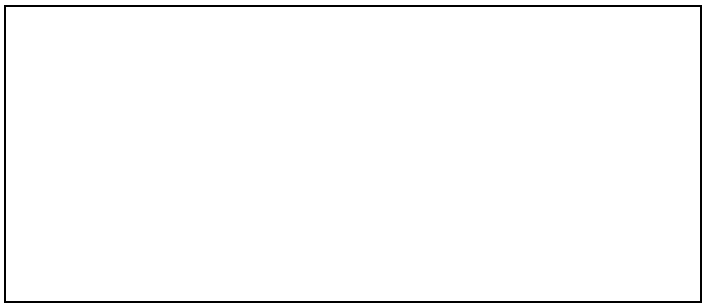
Date _____

1. Predict: what will happen when a drop of water is dropped into the pan of water?

2. Draw observations.

3. Written observations of Slinky

4. Draw a picture of a wave and label.



5. Describe observations of equal-sized pulses.

6. Distinguish among the wavelength, frequency, and period of a wave.

7. What is the amplitude of a wave, and what does it measure?

8. What is the midpoint?

9. If you want to increase the wavelength of waves in a rope, should you shake it at a higher or lower frequency?

10. Distinguish between a mechanical wave and an electromagnetic wave.

11. When a wave crosses a boundary between thin and thick rope tied together, its wavelength and velocity change, but its frequency does not. Explain why the frequency is constant.

12. In step six, is the Slinky producing a transverse or longitudinal wave?

13. What did you learn from this activity?

Resources

NASA
For information on exploratory missions, manned spaceflight, and more, please visit this website.
www.nasa.gov

American Radio Relay League (ARRL)
http://www.arrl.org

Radio Amateur Satellite Corporation (AMSAT)
http://www.amsat.org