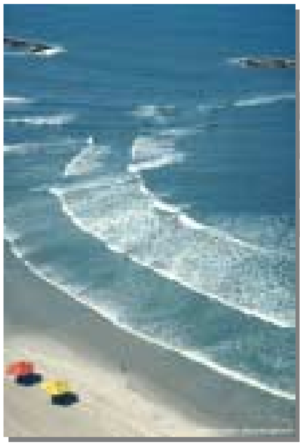


#8948

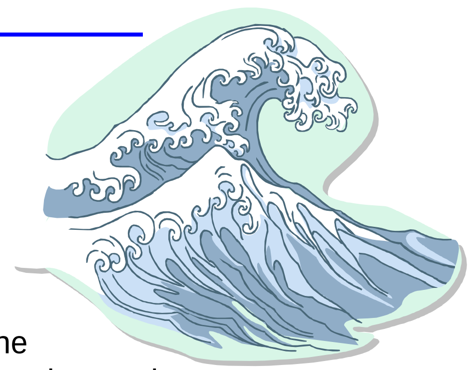
WAVES

Grade Levels: 11-13+
15 minutes
BENCHMARK MEDIA 1999

DESCRIPTION

Everyday examples and laboratory experiments explain and demonstrate the concept of waves as they relate to physics. Three segments cover the characteristics of transverse and longitudinal waves and the reflection and refraction of waves. Complex physics is made clearer by the lab demonstrations.

ACADEMIC STANDARDS



Subject Area: Physical Sciences

- Standard: Understands forces and motion
  - Benchmark: Knows that apparent changes in wavelength can provide information about changes in motion because the observed wavelength of a wave depends upon the relative motion of the source and the observer; if either the source or observer is moving toward the other, the observed wavelength is shorter; if either is moving away, the wavelength is longer
  - Benchmark: Understands general concepts related to the theory of special relativity (e.g., in contrast to other moving things, the speed of light is the same for all observers, no matter how they or the light source happen to be moving; the laws of physics are the same in any inertial frame of reference
- Standard: Understands the sources and properties of energy
  - Benchmark: Knows that waves (e.g., sound, seismic, water, light) have energy and can transfer energy when they interact with matter
  - Benchmark: Knows the range of the electromagnetic spectrum (e.g., radio waves, microwaves, infrared radiation, visible light, ultraviolet radiation, x-rays, gamma rays); electromagnetic waves result when a charged object is accelerated or decelerated, and the energy of electromagnetic waves is carried in packets whose magnitude is inversely proportional to the wavelength

INSTRUCTIONAL GOALS

1. To introduce key concepts about waves.
2. To examine the nature of waves, and transverse and longitudinal waves.
3. To demonstrate reflection and refraction of sound and light waves.

Captioned Media Program
VOICE 800-237-6213 – TTY 800-237-6819 – FAX 800-538-5636 – WEB www.cfv.org
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BACKGROUND INFORMATION

Waves are disturbances that carry energy. We can see waves along the surface of water as the water moves up and down and the energy moves downwind. We can hear *sound waves* within the frequencies audible to our ears, which are vibrations of the transmitting medium. We can see light waves only in the arrow range of the visible electromagnetic spectrum that the cones and rods on the retina of our eyes are sensitive to.

Waves took on a new meaning in the early part of the 20th century when experiments showed that our traditional view of energy as waves and matter as particles became less distinct. The quantum theory evolved as we began to realize that both energy and matter have properties of both waves and particles.

BEFORE SHOWING

1. Have you ever noticed an object floating in water? Why does the object remain nearly in the same place as the wave passes?
2. What is the speed at which waves of light travel?
3. How is sound like light, and how is it different?

AFTER SHOWING

Discussion Items and Questions

1. As a physicist thinks of them, what are *waves*?
2. How does matter differ from energy?

Applications and Activities

1. Organize and conduct demonstrations that show how sound and light waves are refracted and reflected.
2. Obtain a long, coiled Slinky, and tie a ribbon to one coil. Stretch it out between two people so that the tension stretches the spring. If a person at one end quickly vibrates the Slinky to the side and back, you can observe the sideways wave travel to the far end of the Slinky. This is a transverse wave. Repeat the procedure, but this time quickly vibrate the spring toward the person at the far end and then back. The impulse that moves along the spring this time is a longitudinal wave. Note that the ribbon in both cases oscillates in place, but the wave energy is passed along.
3. Make a ripple tank with a shallow, transparent pan of water on a light source, such as the platen of an overhead projector. (Do not allow water to spill into the projector!) Quickly touch the surface of the water with a small object such as the end of a pencil. Notice how the waves travel outward and how they are reflected by the sides of the container. Place objects like wooden blocks in the pan and observe

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how the waves change frequency and direction when they encounter the obstacles. Try placing a barrier with two narrow openings.

4. Ask students to devise and conduct their own experiments to measure the speed of sound and the speed of light.

RELATED RESOURCES

Captioned Media Program

- Sound Science: You Can Do It! #2108
- What Is Light? #2587

World Wide Web

The following Web sites complement the contents of this guide; they were selected by professionals who have experience in teaching deaf and hard of hearing students. Every effort was made to select accurate, educationally relevant, and "kid-safe" sites. However, teachers should preview them before use. The U.S. Department of Education, the National Association of the Deaf, and the Captioned Media Program do not endorse the sites and are not responsible for their content.

- **MAGNETIC FIELD LINES—HISTORY**

http://www-spof.gsfc.nasa.gov/education/whfldlns.html

Read a brief history of electrochemistry, including that an electromagnetic wave was possible. Click on "Next Stop: #6. Electromagnetic Waves" at the end of the article to read about this topic.

- **VIBRATING CHARGES AND ELECTROMAGNETIC WAVES**

http://www.colorado.edu/physics/2000/waves_particles/wavpart4.html

Use your mouse to drag the negative charge up or down, then let it go to start it oscillating. Use the slider to adjust spring tension. Also, read more about the connection between wavelength, frequency and the speed of light.

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