

## Learning Objectives

- 1) Realize that sound is energy, and know how it travels. Sound begins when energy produces a vibration that causes a disturbance in the molecules of the medium in which the sound is to travel. The energy is transferred through a medium via waves.
- 2) Describe sound waves. Sound travels through longitudinal, or compression–rarefaction, waves. Sound causes a disturbance that pushes molecules away from it. This creates a series of compressions (where the molecules of a medium are squeezed together) and rarefactions (where the molecules of a medium are stretched apart), called a longitudinal wave, through which sound energy travels.
- 3) Understand that sound must have medium through which it can travel. It is necessary to have molecules present so that they can bounce off each other and transfer the sound energy.
- 4) Know that the speed of sound at standard temperature and pressure (about 68° F at sea level) is 760 mile per hour (approximately 340 meters per second); this speed is referred to as Mach 1. Any object that travels faster than Mach 1 is said to be super sonic.
- 5) Realize that the speed at which sound waves travel depends on two factors:
  - a) The density of the medium – Density describes how closely packed the molecules are in a medium. The denser a medium is, the faster sound will travel inside it. This is because the close proximity of the molecules allows them to bounce off of each other (transfer energy from one molecule to the next) more rapidly, or renders the medium more elastic.
  - b) Temperature – The higher the temperature of a medium, the faster its molecules move. Consequently, sound travels faster in mediums that are higher in temperature.
- 6) Realize that analyzing the properties of a sound wave allows one to obtain measurements including the loudness, pitch, and energy of a sound. It is easier to analyze sound if it is represented as an “up and down” (transverse) wave, containing a series of crests, which represent compressions, and troughs, which represent rarefactions. The distance between the center of a sound wave and the crest or trough is the wave’s amplitude (measured in decibels). The higher the amplitude, the louder the sound. Wavelength is the distance between two adjacent crests or troughs; the shorter the wavelength, the higher the frequency. Frequency, measured in Hertz (Hz), describes the number of waves that pass a certain point in a given time period. The higher the frequency, the higher the pitch of the sound. Also, the higher the frequency, the more energy a sound has.
- 7) Understand how animals can use sound to navigate and locate objects. Bats have very poor eyesight, so they use sound to help them navigate. Bats do this by sending out a sound and listening for the echo. This process, called echolocation, allows bats to tell how far away an object is and what the object is. Humans also use echolocation. Sonar is a system that sends out a sound signal that bounces off an object and comes back to the source. By knowing the speed of sound and the time it took for the signal to return to the source, humans can calculate how far away the object is.
- 8) Know how sound is heard. Sound waves travel through the air and vibrate the eardrum. These vibrations are turned into nerve impulses that the brain perceives as sound.

## Suggested Activity

- 1) **Cup phone experiment.** Have students work in pairs or small groups. Using Styrofoam cups, plastic cups, and paper cups, have each group of students make “cup phones” by punching a hole in the bottom of each matching cup and tying a string

inside to connect two cups. Have students experiment to see which cup conducts sound the best. Try these other variables: Length of string, size of hole in bottom of cup, amount of string touching surface of cup.

- 2) **Sign Language.** Review the mechanics of the human ear in conducting sound. Teach students simple phrases or words in American Sign Language (there are many terrific websites devoted to this). Let interested students research hearing aid devices or cochlear implants and present their findings to the class. Other students can learn a song or story in ASL and present it to the class.

## Vocabulary

**Decibel** — A measure of the amplitude of a sound wave.

**Echo** — The repetition of a sound due to the reflection of sound waves.

**Echolocation** — The process of using echoes to detect objects.

**Hertz** — A measurement of frequency (1 Hz = 1 wave cycle per second).

**Pitch** — A judgment of a sound’s frequency (i.e., how high or low sound is).

**Sonar** — Sound Navigation And Ranging

**Vibration** — A movement either back and forth or up and down.

