Sound

- ## Sound
  - **If a tree falls in the woods away from any living being, would there be a sound?**
  - **Waves from _____ of a material: guitar string, vocal chord, explosion.**
  - **_____ sound waves with frequencies *below 20 Hz* (that humans can't hear).**
  - **_____ sound waves with frequencies *above 20 kHz* (that humans can't hear).**

- ## Sound in Air
  - **_____ are *pulses*: nonperiodic from hand clap, periodic from guitar string.**
  - **_____ are *low pressure regions* behind compressions. A wave is made of both.**
  - **Microphone air wave frequency … causes same E&M frequency … which drives speaker (still E&M) … which causes air compression/rarefaction waves, still at original frequency.**
  - **Any _____ media (besides air) transmits sound – if it *compresses and bounces back*.**

- ## Speed of Sound
  - **_____ *miles/hr* (330 m/sec) in air, 3,000 miles/hr in water – on a humid day it travels faster**
  - **Light (E&M waves) travel about *a _____ times faster*: 186,000 miles/sec ($3x10^8$ m/sec)**

- ## Reflection of Sound
  - ***1 reflection* = _____, *many reflections* = _____, *0 reflections* = _____**
  - **The angle of sound in (*angle of incidence*) = the angle of sound out (*angle of reflection*). (The design of the opera hall in San Francisco has plastic reflectors that are above the musicians. The audience gets reflected light and sound, so what you see is what you hear!)**

- ## Refraction of Sound
  - **_____ of sound is the *bending of sound*. Ex: uneven winds, uneven temperatures. Ultrasonic waves are bounced off a submarine in the ocean and a fetus in the womb. These sound waves are reflected and refracted. The Doppler Effect helps interpret the results. Dolphins and bats are mostly dependent on sound to "see".**

- ## Sound Waves
  - **Light waves (E&M) – as from the Sun have great energy. *Sound wave energy is small*. It would take 10,000,000 people talking to light a flashlight.**
  - **_____ _____ of your voice box or an acoustic guitar amplifies the original sound wave because a larger, *additional surface is vibrating*, setting up a larger air compression wave.**
  - **Every elastic object has a _____ _____ – the frequency it freely emits if tapped. You hear this if you drop a fork or the bat hits the baseball.**
  - **_____: *a forced vibration of an elastic object at its natural frequency*. Objects in resonance can increase dramatically in amplitude. Ex: a child learns to pump on a swing at the resonant frequency, Tacoma Narrows Bridge.**
  - **_____ _____: *two objects with the same natural frequency causing each other to vibrate*. Ex: violins, tuning forks, humankind.**

- ## Interference
  - **_____: *to be in the same place* is possible with waves.**
  - **_____ if *waves are in phase*.**
  - **_____ if *waves are out of phase*.**

    Speakers in a surround sound system have to be sure to be in phase or else you hear a beating sound. Jack hammer operators have headphones with out of phase sound chips.