Sound Waves

Sound is a form of energy resulting from oscillations in pressure (or density) of the medium in which the sound is travelling.

Sound is a longitudinal wave, since the particles vibrate parallel to the motion of the wave, creating areas of alternating high and low pressure. The areas of high pressure are called compressions and the low pressure areas are rarefactions.

http://www.physicsclassroom.com/class/sound/u11l1c.cfm

We are able to hear SOME sound, depending on its frequency and volume. (The volume is proportional to the amplitude of the wave.)

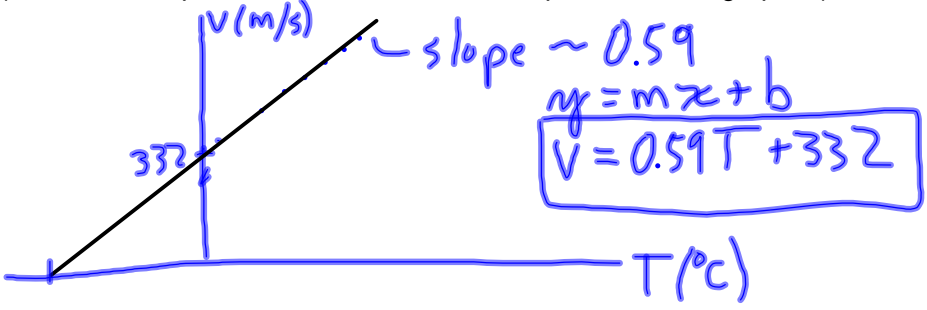
Frequencies that are in the range of human hearing (20 Hz to 20 000 Hz) are said to be audible. Frequencies above this range are called ultrasonic and frequencies below are said to be infrasonic.

The Speed of Sound

Since sound waves propagate based on the density of the particles in their medium, it would make sense that the speed of the wave depends on the characteristics of the medium. For that reason, the speed of sound changes based on the medium through which it is travelling.

Eg.	material	speed (m/s)
	-air (0 °C)	332
	-water	1500
	-steel	5000

There is also a temperature dependance in most media. This dependency can be determined experimentally.
(Measure the speed of sound at different temperatures and graph it.)



Examples:

Determine the wavelength in air at 20°C of a 440 Hz sound.

$T = 20°C$
$f = 440\ Hz$
$\lambda = ?$
$V = ?$

$V = 332 + 0.59T$
$= 332 + 0.59(20)$
$= 332 + 11.8$
$= 343.8\ \frac{m}{s}$

$V = f\lambda$
$\lambda = \frac{V}{f} = \frac{343.8}{440}$
$= 0.78\ m$

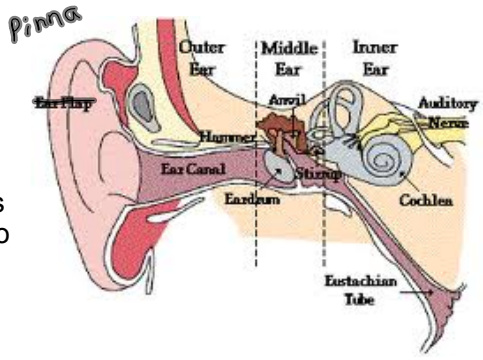
Human Hearing

Outer Ear: Sound Collection

Sound waves are funneled into the ear by the pinna, where it is amplified. It then travels down the ear canal before striking the eardrum, which is a thin tissue than is stretched tight over the end of the ear canal.

Middle Ear: Transfer Station

The vibration of the eardrum is transferred to 3 tiny bones (the hammer, anvil, and stirrup) where it is amplified slightly. This vibration causes the cochlea to vibrate.



Inner Ear: Sorting Station

The cochlea is a fluid-filled sac containing thousands of tiny hair-like structures called cilia. When the cochlea vibrates, the motion of the fluid causes the cilia to vibrate. However, each cilia has its own resonance frequency. If the frequency of vibration of the cochlea (which is the same as the incoming sound) is the same as the resonance frequency of a particular cilia, then that cilia will vibrate. Each cilia is attached to a nerve ending. When a cilia vibrates, it sends a signal through this nerve to the auditory nerve where it is received by the brain and interpreted.