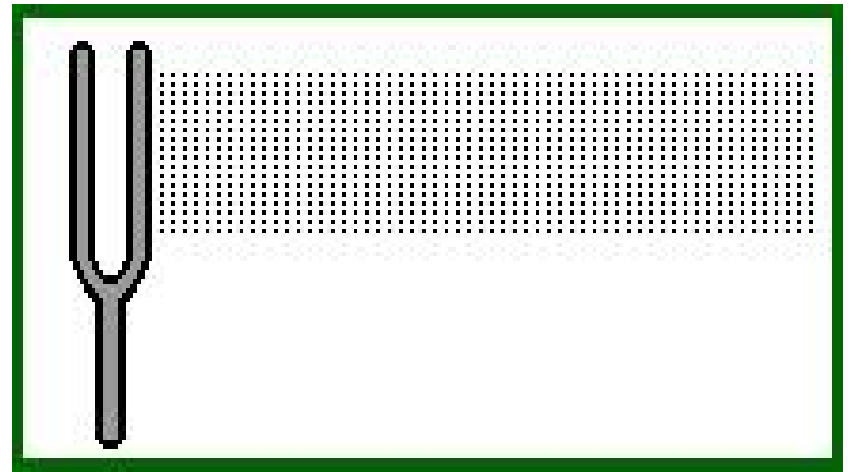


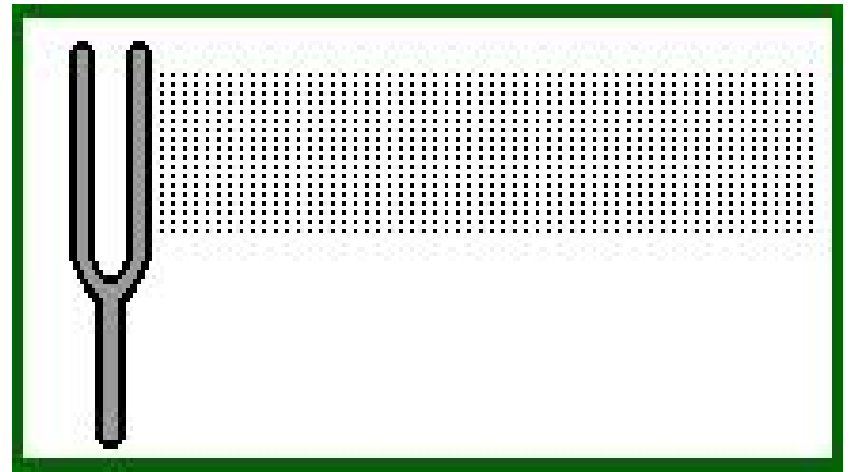
Sound

What *is* Sound?



- Sound is a longitudinal wave traveling through a physical medium.
- Sound can occur in any form of matter: solid, liquid, gas, or plasma. (It cannot exist in a vacuum.)
- The source of a sound wave is a vibrating object that initiates the disturbance.

What *is* Sound?



- The speed of a sound wave is determined by the properties of the medium through which it travels (independent of the source).
- The frequency of a sound wave always equals the frequency of the source (independent of the medium).

The Speed of Sound

- In air at 0 °C, $v = 331$ m/s (740 mph).
- The speed increases at higher temperatures by about 0.6 m/s per degree.
- In air at 20 °C, $v = 343$ m/s (767 mph).
This is at “room temperature” 68 °F.
Unless stated otherwise use this value!
- Speed of sound is much different through solids and liquids...

Speed of Sound

Air (20 °C)	343 m/s
Water	1480 m/s
Sea Water	1520 m/s
Steel	5000 m/s

Human Hearing

sound wave



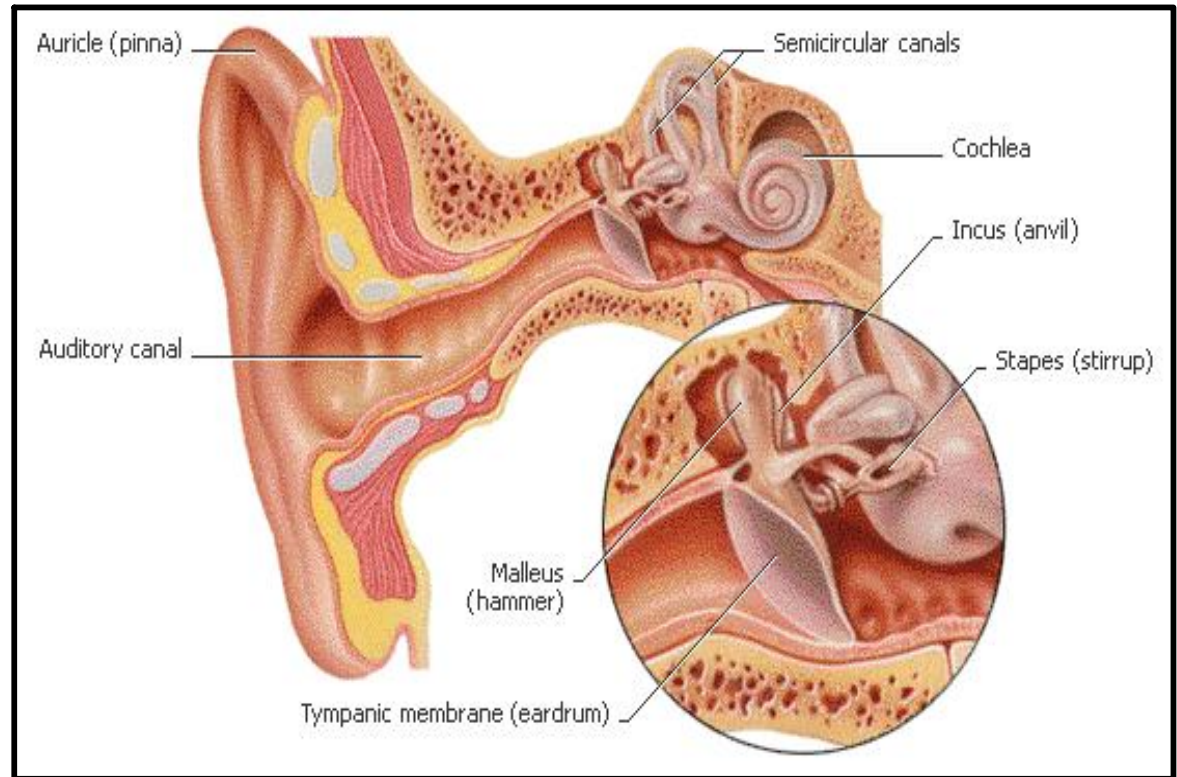
vibrates ear drum



amplified by bones



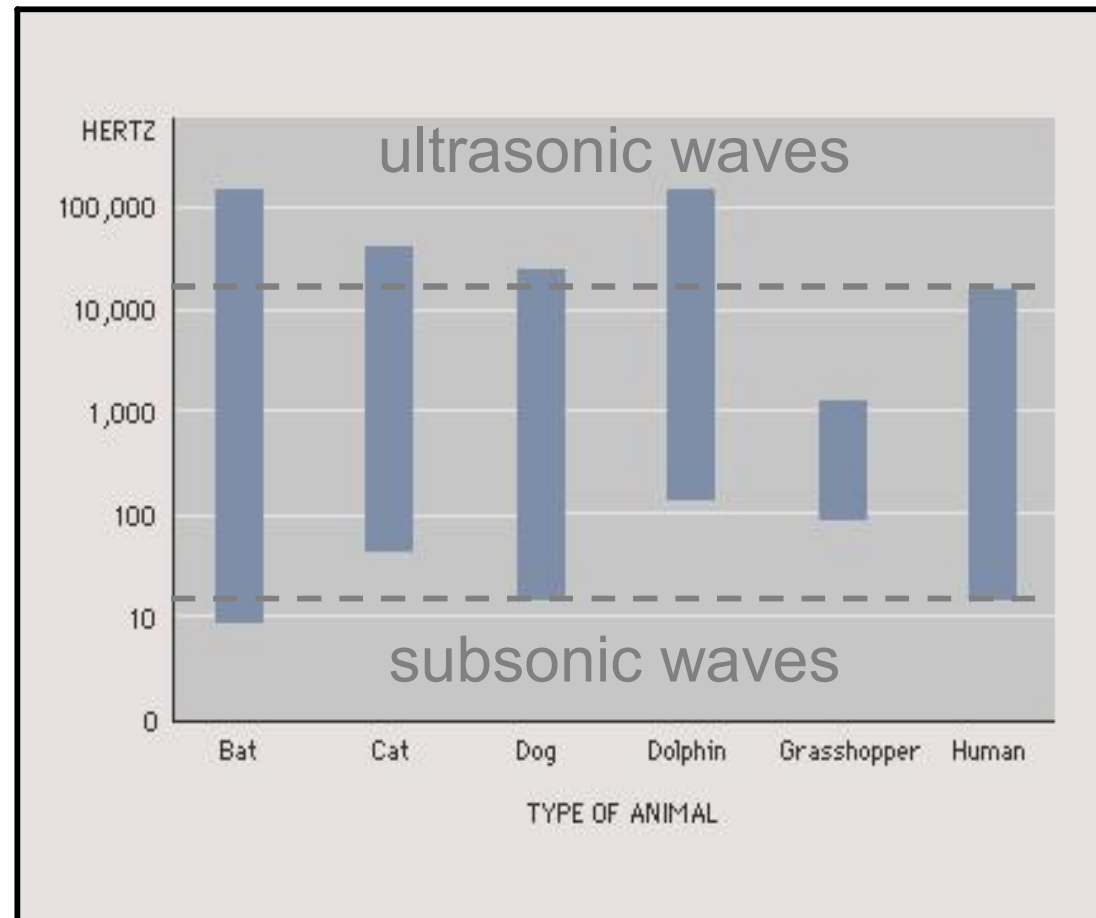
converted to nerve
impulses in
cochlea



Human Hearing

- **Pitch**

- highness or lowness of a sound
- depends on frequency of sound wave
- human range: 20 - 20,000 Hz



A normal person can hear sounds with frequencies as low as 20 Hz and as high as 20 kHz. What is the corresponding range of wavelengths that a typical person can hear?

Answer: as long as 17 m (at 20 Hz) and as short as 17 mm (at 20 kHz)

A scuba diver in a swimming pool listens to an opera singer practicing at the pool's edge. The opera singer hits a note of 1024 Hz. The speed of sound in water is 1500 m/s.

- a) Find the wavelength of the sound as it travels in the air (before entering the water).
- b) Find the frequency and wavelength of the sound as it travels through the water.

Answers: 0.335 m; 1024 Hz, 1.46 m