

# Properties of Sound

Sound waves are very different from electro-magnetic (EM) radiation.

| Sound waves   | X-rays  |
|---|---|
| Mechanical energy   | EM radiation  |
| Requires a medium   | Can travel in a vacuum  |
| Longitudinal wave: particles in the medium move back and forth parallel to the direction the wave is travelling | Transverse wave: electric and magnetic component oscillating at right angles to each other, and to the direction of propagation |
| Variable velocity   | Constant velocity   |

apart (rarefaction). A sound wave can also be represented sinusoidally with the peaks and troughs of the wave corresponding to the areas of maximum compression and rarefaction.

## 1) Frequency

The audible range of sound waves for humans is 20 to 20,000 Hz. 1 Hz is 1 wavelength per second. Medical ultrasound uses frequencies of **2-18 MHz** (1 MHz = 1 million Hz) i.e. above the range of human hearing..

## Anatomy of a Sound Wave

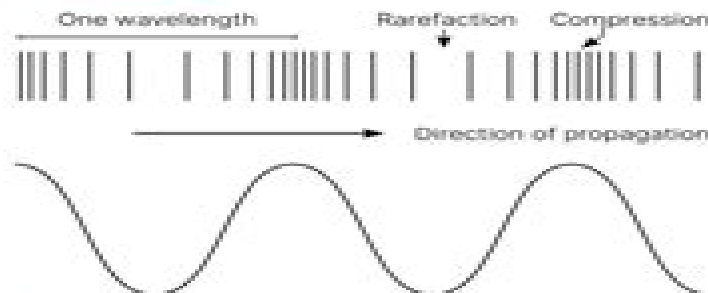


Figure 91. Anatomy of a sound wave

As the sound wave passes through material the particles vibrate back and forth. In some areas the particles are close together (compression) and in others they are further

## 2) Velocity

The velocity of a sound wave is dependent on, and constant for, the material through which the wave is passing.

$$c = \sqrt{k / \rho}$$

Where:  $c$  = speed

$k$  = rigidity

$\rho$  = density

From the above equation, the speed of the sound wave increases with increasing rigidity and decreasing density. It travels the slowest in air as the material is so compressible that a lot of energy is lost between the particles. The important number to learn is that for soft tissues the speed is around 1540 m/s. Ultra-

# Study Guide Properties Of Sound Physics

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## **Study Guide Properties Of Sound Physics:**

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