Medical physics

By:
Dr. AMMAR ALHASAN

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Physics of Electrical and Magnetic Properties

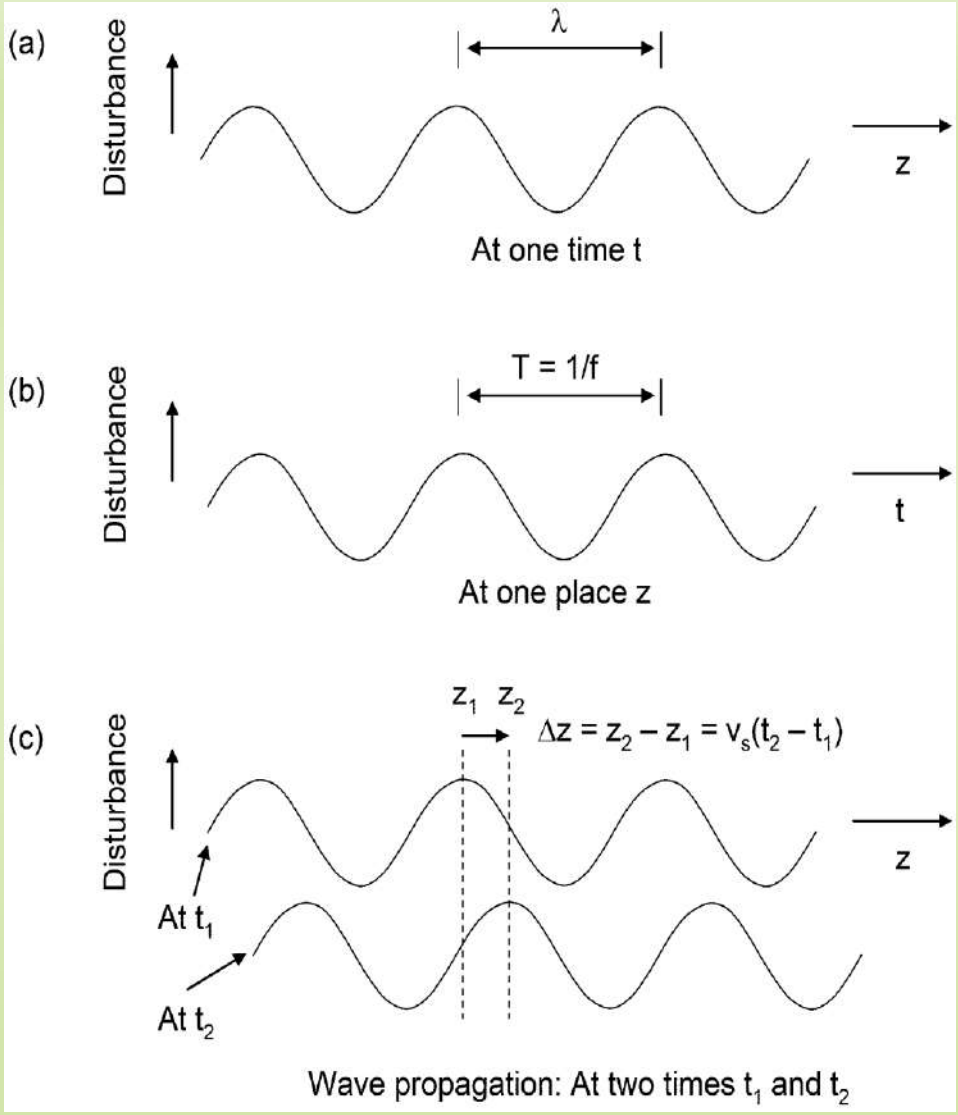
- How do we speak?
- How do we hear?
- physics of sound waves. which is called acoustics

sound waves

- Sound is also important in medical diagnostics. Physicians use stethoscopes to listen to sounds in the body
- Another important medical diagnostic using sound is ultrasonic mapping or ultrasonography
- sound at frequencies transmitted ⇒ The shifting (~1–10 MHz), way above our hearing range (20 Hz–20 kHz), that provides images with the very useful spatial resolution of ~1mm

The Physics of Sound Waves

- **Sound is a mechanical wave produced by vibrating bodies**
- ❖ **Two important characteristics of sound**
- ✓ **intensity, which is determined by the magnitude of compression and rarefaction**
- ✓ **frequency, which is determined by how often the compressions and rarefactions take place. Frequency is measured in cycles per second**



The Speed and Properties of Sound Waves

- In air at 20°C, the speed of sound is about 3.31×10^4 cm/sec
- in water it is about 1.4×10^5 cm/sec.
- In general, the relationship between frequency, wavelength, and the speed of propagation is given

$$v = \lambda f$$

- the total pressure in the path of a sinusoidal sound wave is of the form

$$P = P_a + P_o \sin 2\pi ft$$

where Pa is the ambient air pressure
Po is the maximum pressure change due to the sound wave,
and f is the frequency of the sound.

$$I = \frac{P_o^2}{2\rho v}$$

ULTRASONIC WAVES

- it is possible to produce mechanical waves at very high frequencies
- called *ultrasonic waves.* Because of their short wavelength
- it is possible to form visible images of ultrasonic reflections and absorptions. Therefore, structures within living organisms
- In some cases, such as in the examination of a fetus and the heart, ultrasonic methods can show motion, which is very useful in such displays. The frequency of sound detected by an observer depends on the relative motion between the source and the observer. This phenomenon is called the Doppler Effect.

Absorption of Sound

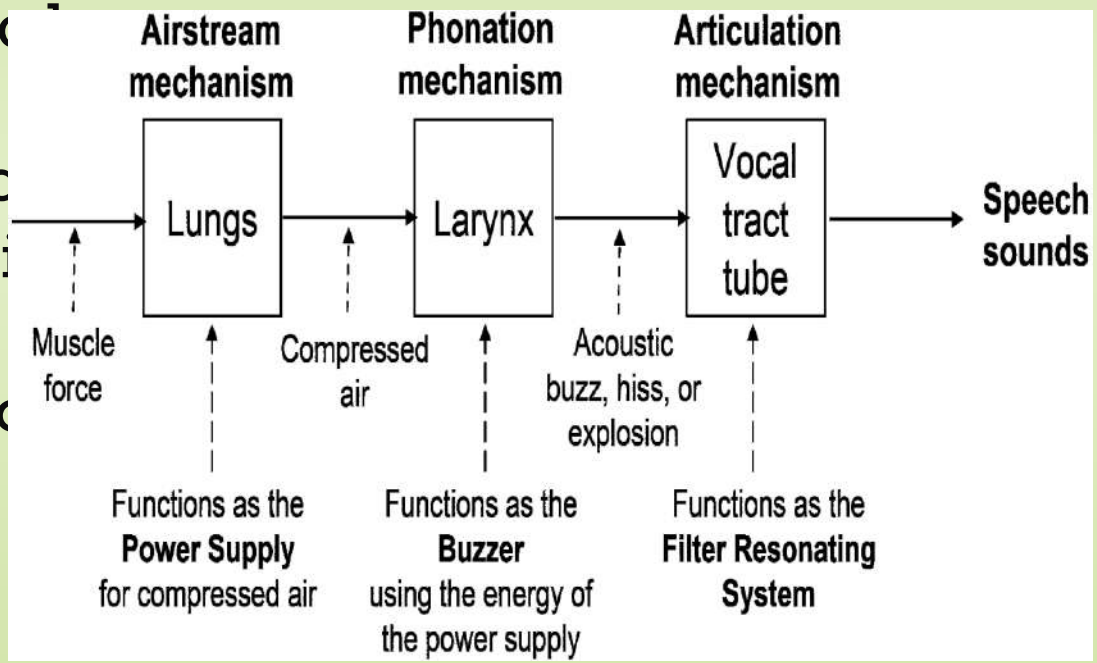
- Within a given medium the sound wave can be attenuated by absorption and scattering. In scattering, part of the propagating beam is redirected into many directions, without being absorbed.

$$A(z) = A(z = 0)\exp(-\gamma_{\text{sound}} F z)$$

$$I(z) = I(z = 0)\exp(-\alpha_{\text{light}}\, z).$$

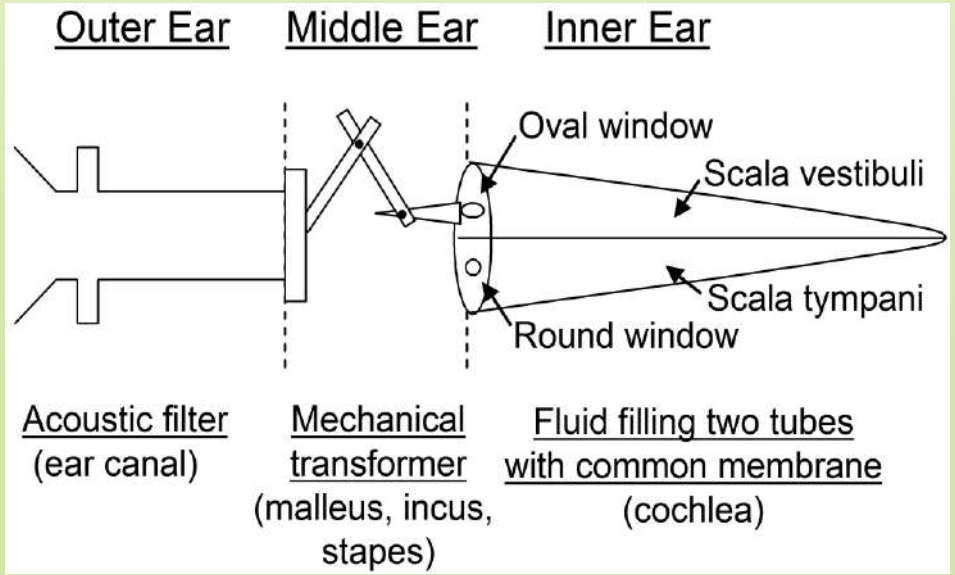
Systems in Speech Production

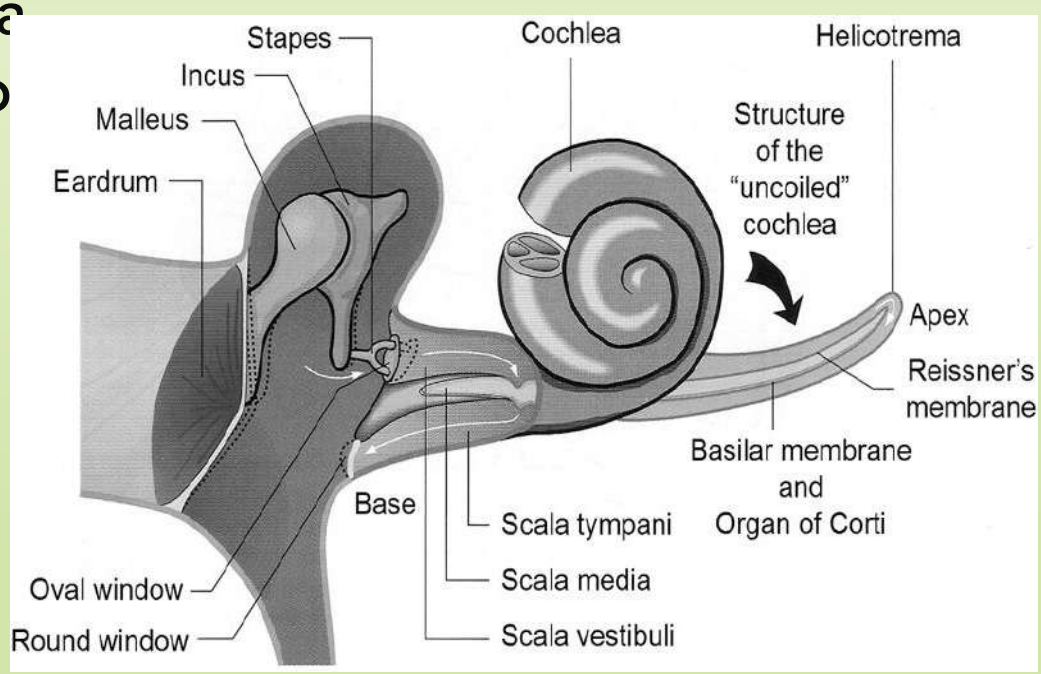
- (a) The lungs are the airstream mechanism in which muscle force is used to produce a stream of compressed
- The larynx is the phonation mechanism, which takes the compressed air and turns it into an acoustic
  hiss, or explosion.
- (c) The vocal tube track is the articulation mec
  which takes the larynx sounds and turns them i
  speech sounds.
- (4) This wave moves the basilar membrane upo
  the primary auditory receptors



Hearing

- There are four steps in the hearing process within the ear:
- The sound wave enters the outer ear
- The movement of the tympanic membrane is transferred by conduction through the ossicles to the oval window of the cochlea.
- (3) The movement of the oval window generates a compressional (sound) wave in the fluid of the co






Thank you