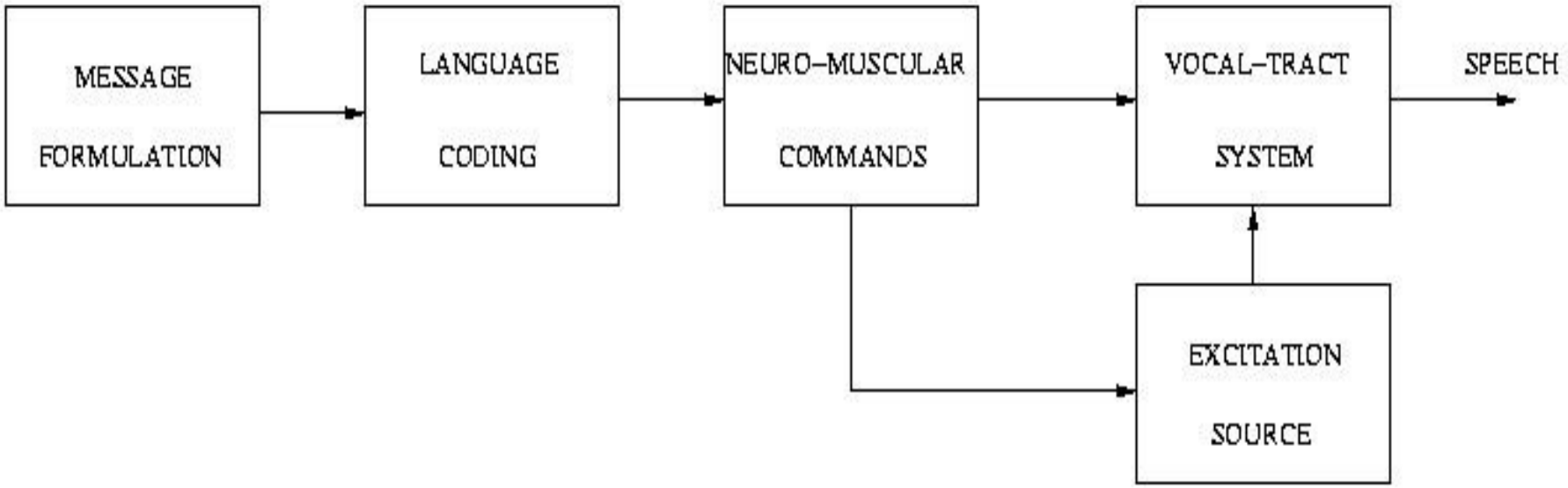
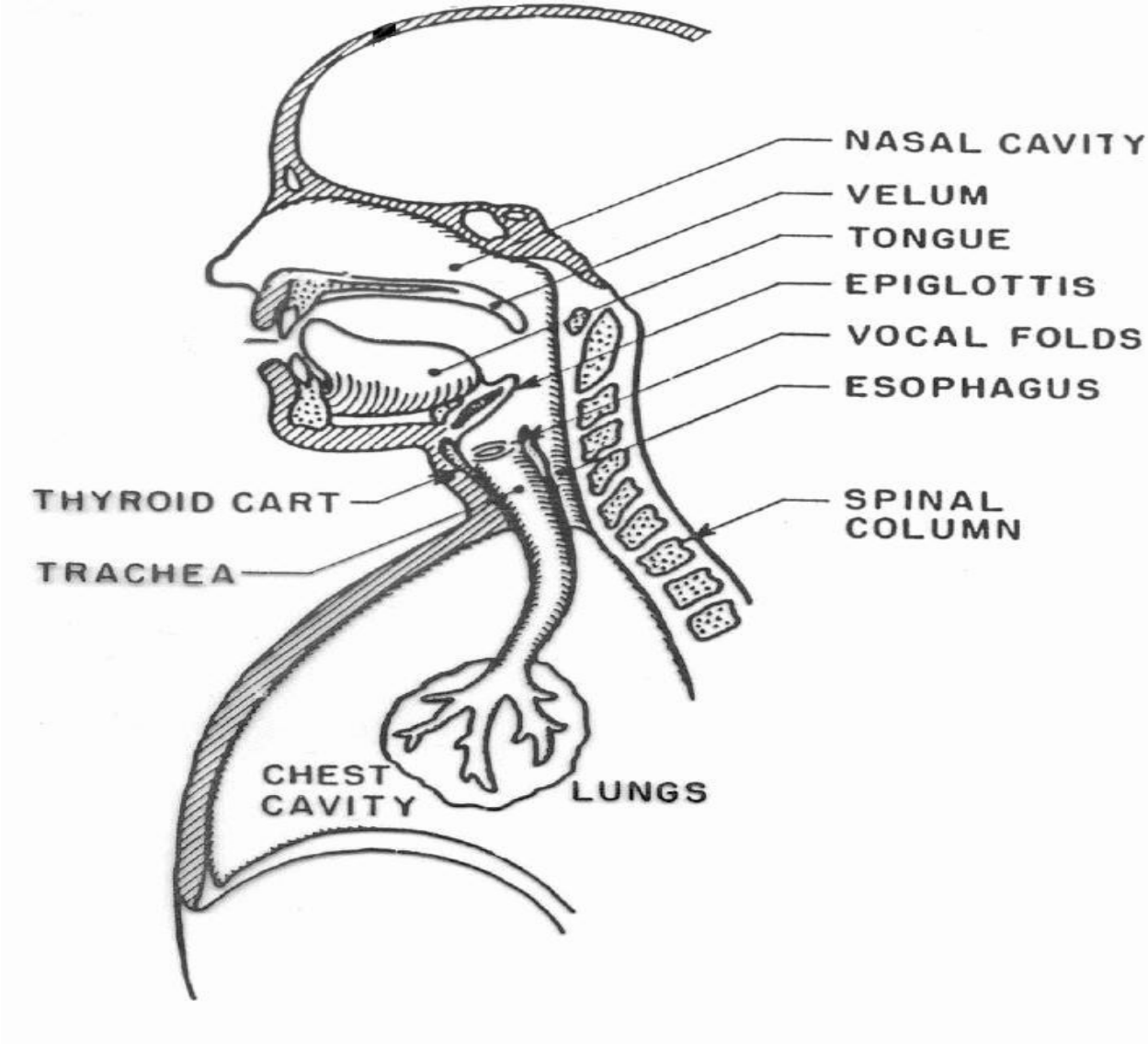
PART-I: Speech Production

Block Diagram of Speech Production



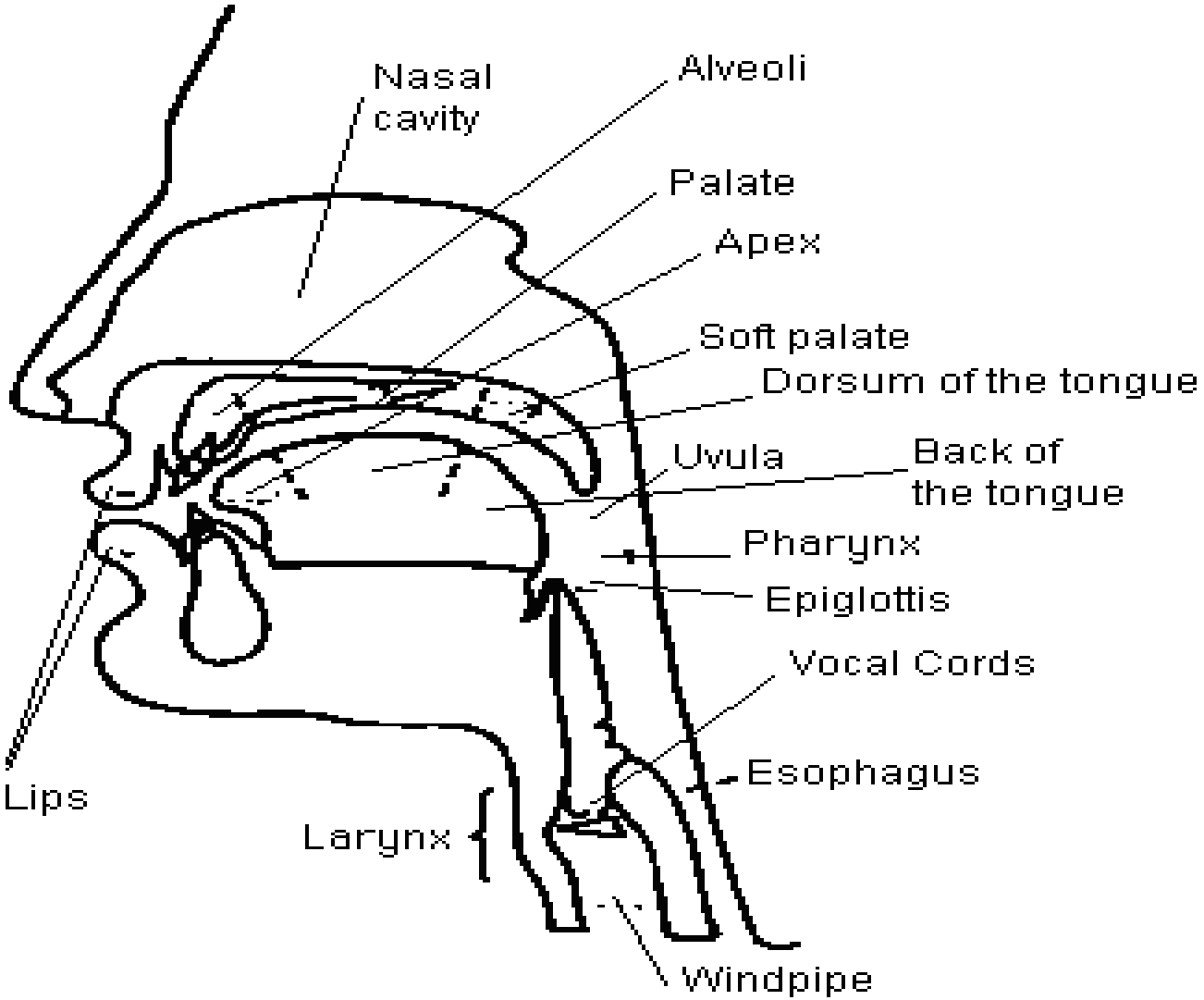
Physiological Model of Speech Production



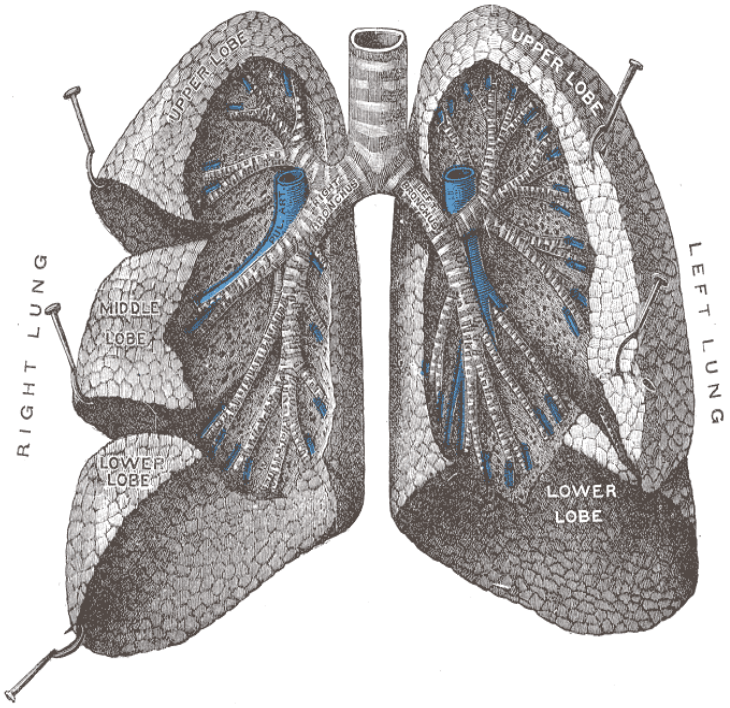
Speech Production Mechanism

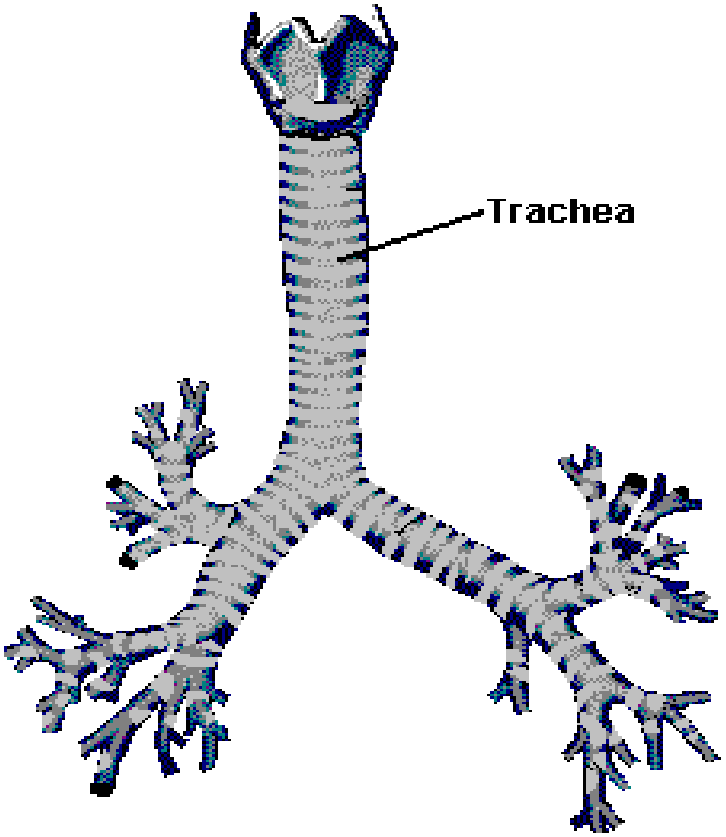
- Speech is produced during exhalation of air
- Lungs & associated structure provide required energy
- Vocal-folds inside larynx is the main excitation source and constriction inside vocal tract is an additional source
- Supra-glottal system which includes pharynx, oral cavity and nasal cavity behave as time-varying resonator

Oral and Nasal Cavities

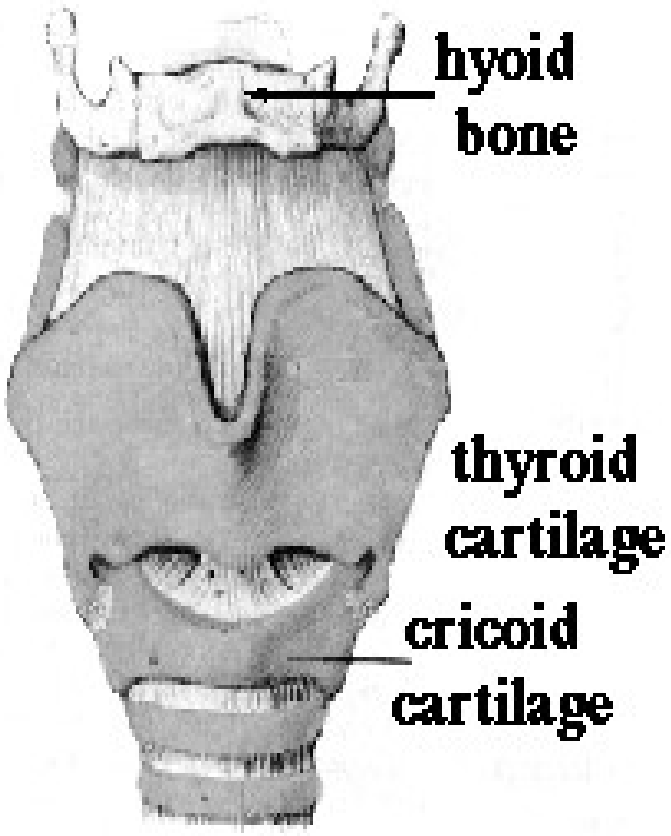


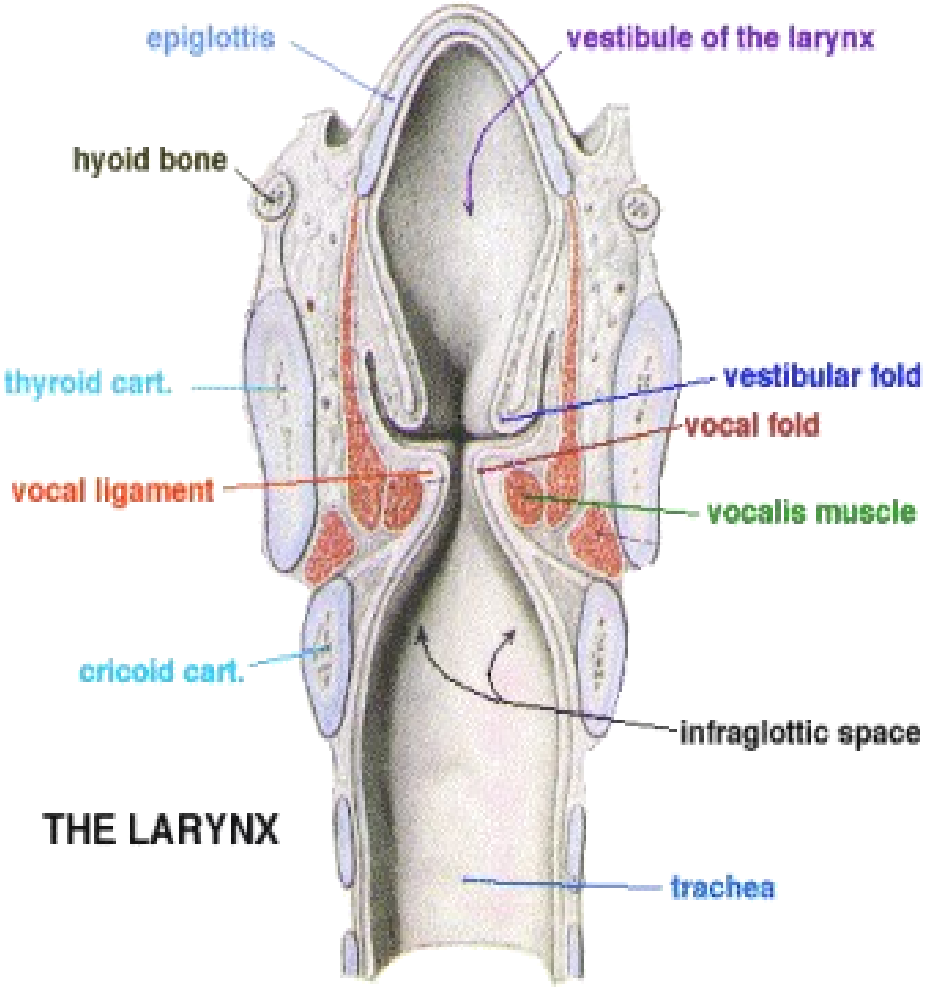
Lungs and Trachea



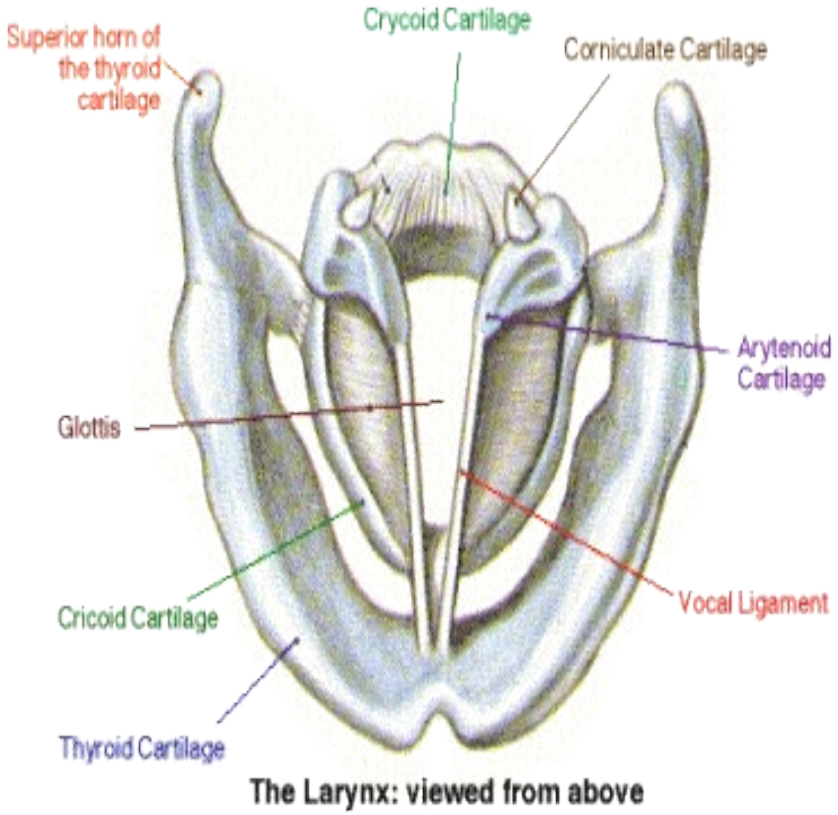


Larynx (Voice Box)



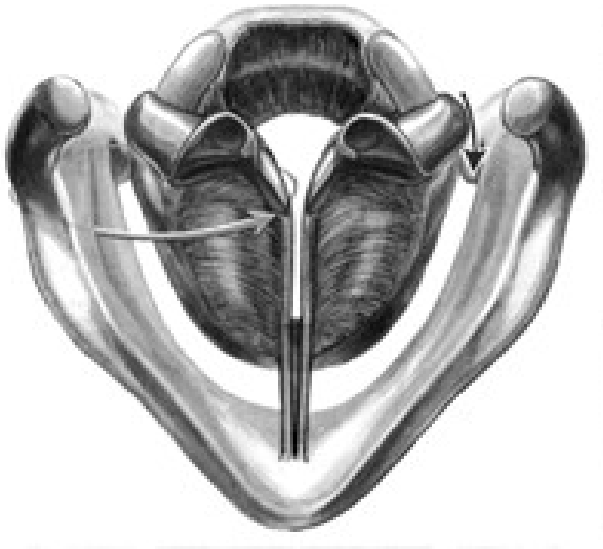


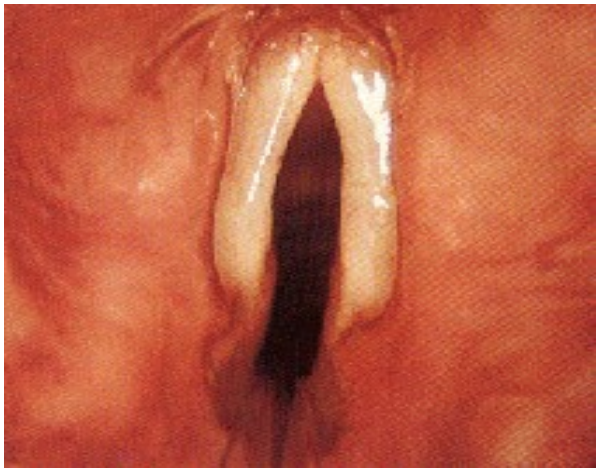
Larynx (contd.)



The Larynx: viewed from above

Vocal Folds





Vocal Folds (contd.)

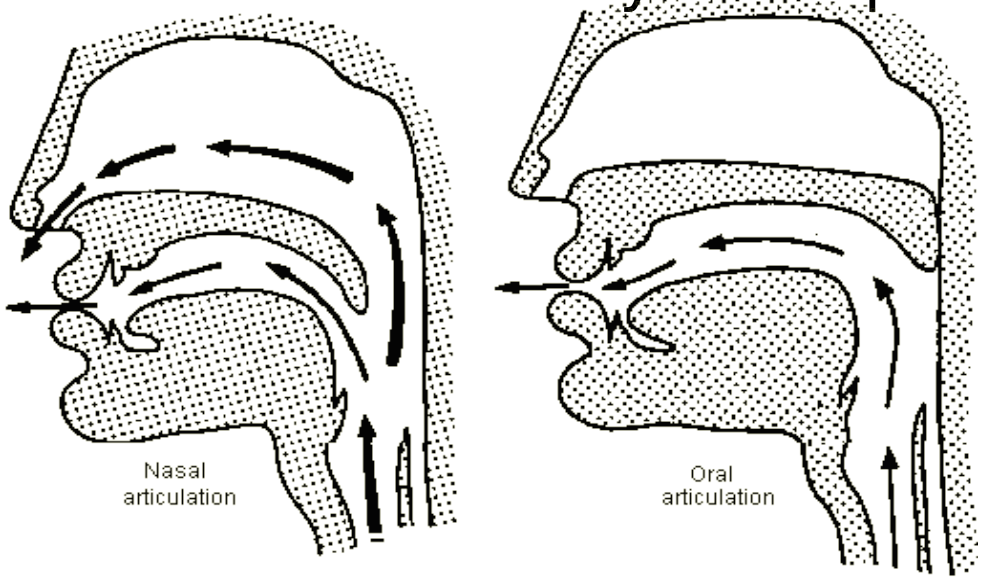
- During phonation, the vocal folds are brought together near the center of the larynx by muscles attached to the arytenoids.
- As air is forced through the vocal folds, they vibrate due to Bernoulli effect and produce sound.
- By contracting or relaxing the muscles of the arytenoids, the qualities of this sound can be altered.
- As the sound produced by the larynx travels through the pharynx and mouth, it is further modified to produce speech.

Oral and Nasal Cavities (contd.)

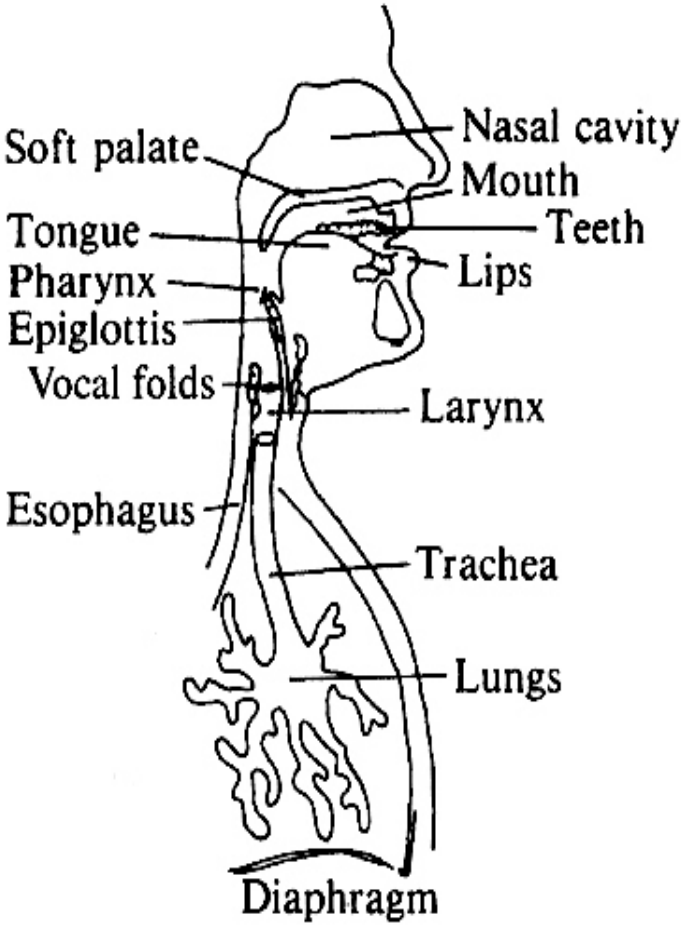
- Oral cavity - passage for food and water
- Nasal cavity - passage for air
- Oral articulators - velum, tongue, jaws, teeth and lips
- Dimension depends on positioning of various articulators
- Variable dimension resonator for speech production
- Resonance value depends on shape of vocal tract system

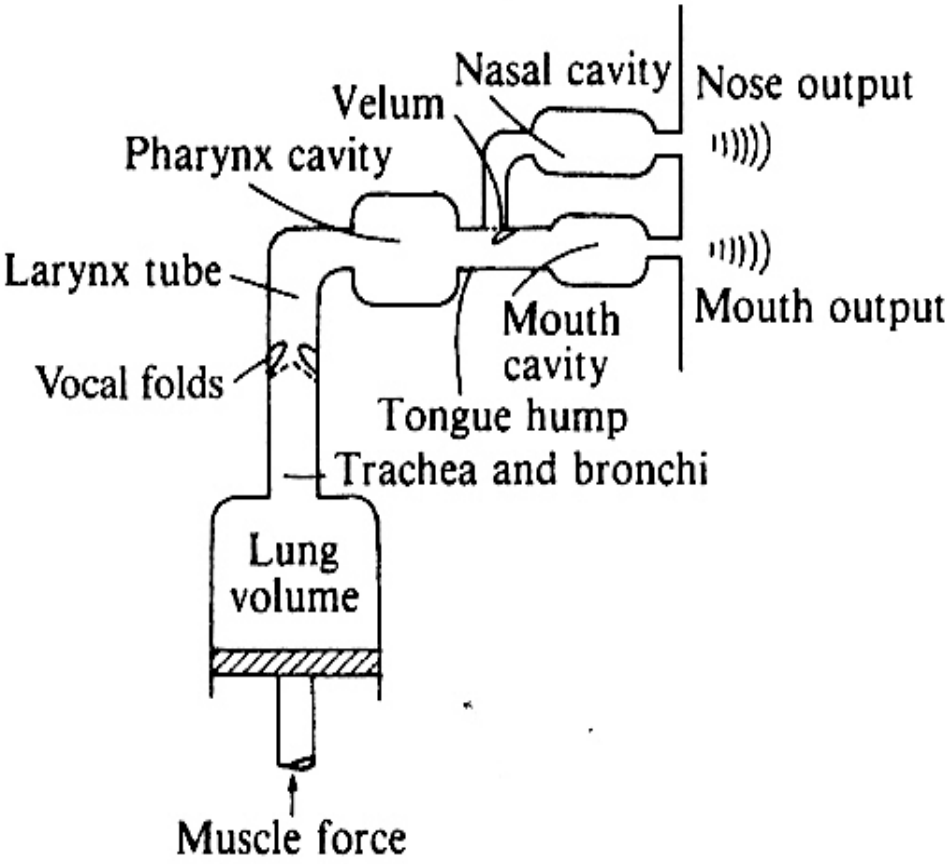
Production of Speech Sounds

- Vowels - Oral cavity is wide opened, tongue hump, glottal vibration
- Unvoiced Consonants - constriction
- Voiced Consonants - constriction & glottal vibration
- Nasal Sounds - nasal cavity is coupled



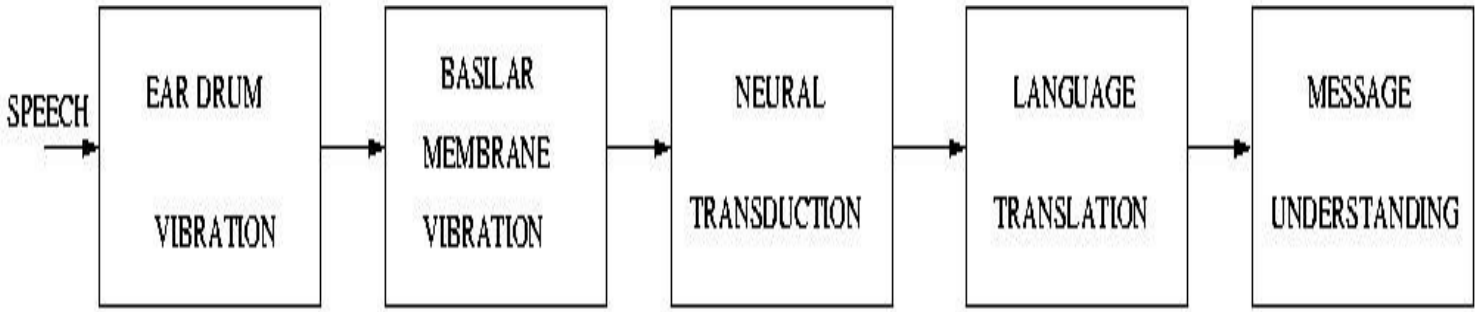
THE VOCAL ORGANS



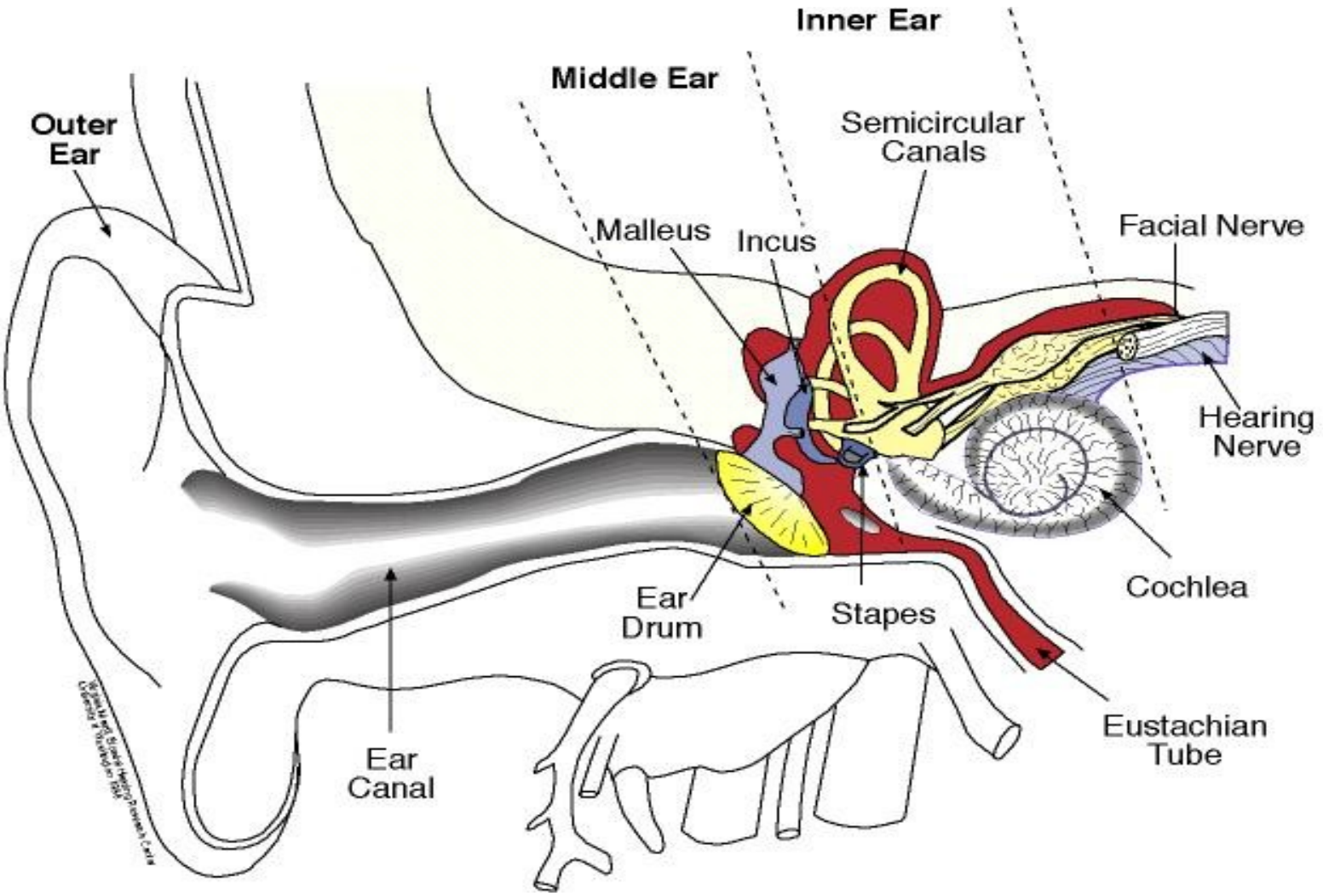


PART-II: Speech Perception

Block Diagram of Speech Perception



Physiological Model of Human Ear



Speech Perception Mechanism

- Mainly three regions - outer ear, middle ear & inner ear
- Outer ear - directs speech pressure variations towards the middle ear
- Middle ear - transforms pressure variations into mechanical motion
- Inner ear - converts mechanical vibrations into electrical firings in the auditory neurons, which leads to brain
- Language decoding and message understanding at the higher centers of learning which is less understood

Speech Technology: An Interdisciplinary Approach

- Signal processing
- Acoustics
- Pattern recognition
- Information theory
- Linguistics
- Physiology
- Computer Science