Anatomy of Speech Production

Ozarks Technical Community College

HIS 120

Requirements for Speech Production

- Respiration
- Phonation
- Articulation
- Resonance

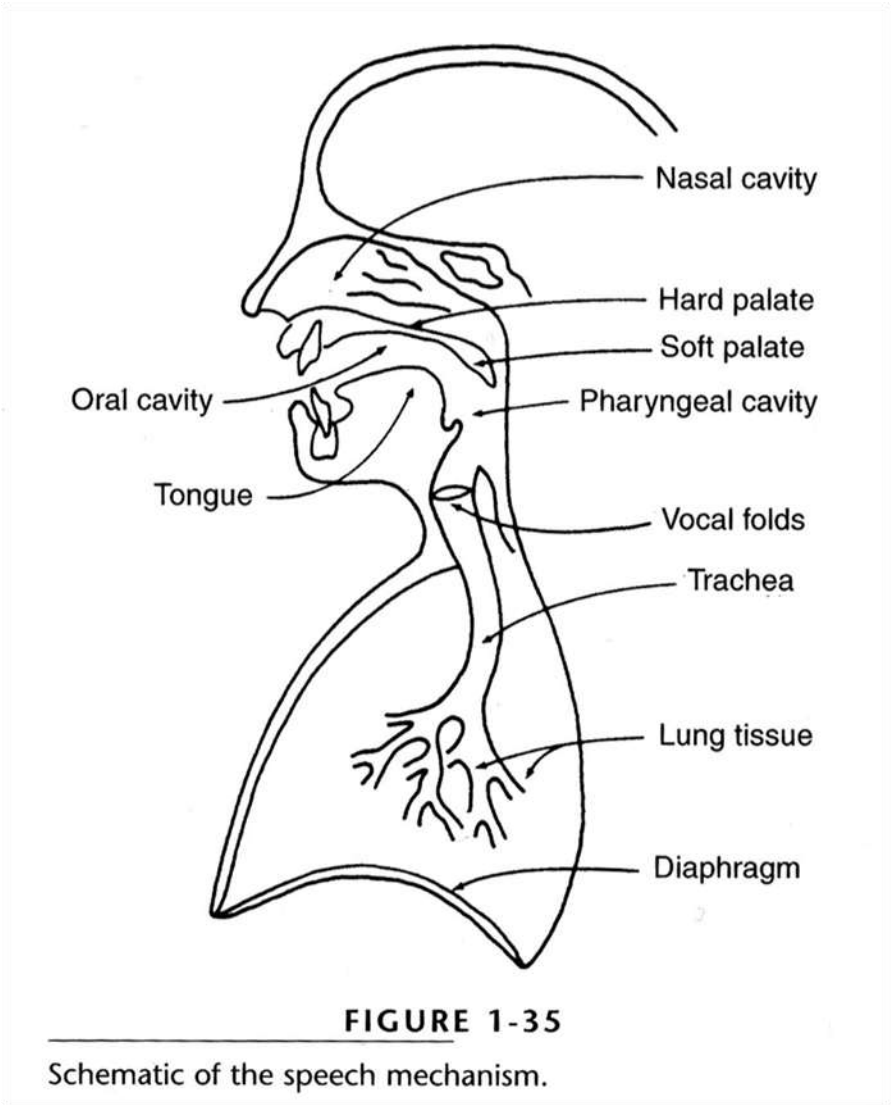

FIGURE 1-35

Schematic of the speech mechanism.

Image from Zemlin text

What is required for sound production?

- Sound production requires two things:
  - Power/energy source
  - Vibrating element

- When it comes to speech production, the power source is **air** that comes from the lungs and the vibration occurs in the **vocal cords**

The Respiratory Passage

- Nasal Cavity
- Oral Cavity
- Pharynx
- Larynx
- Trachea
- Bronchi
- Lungs

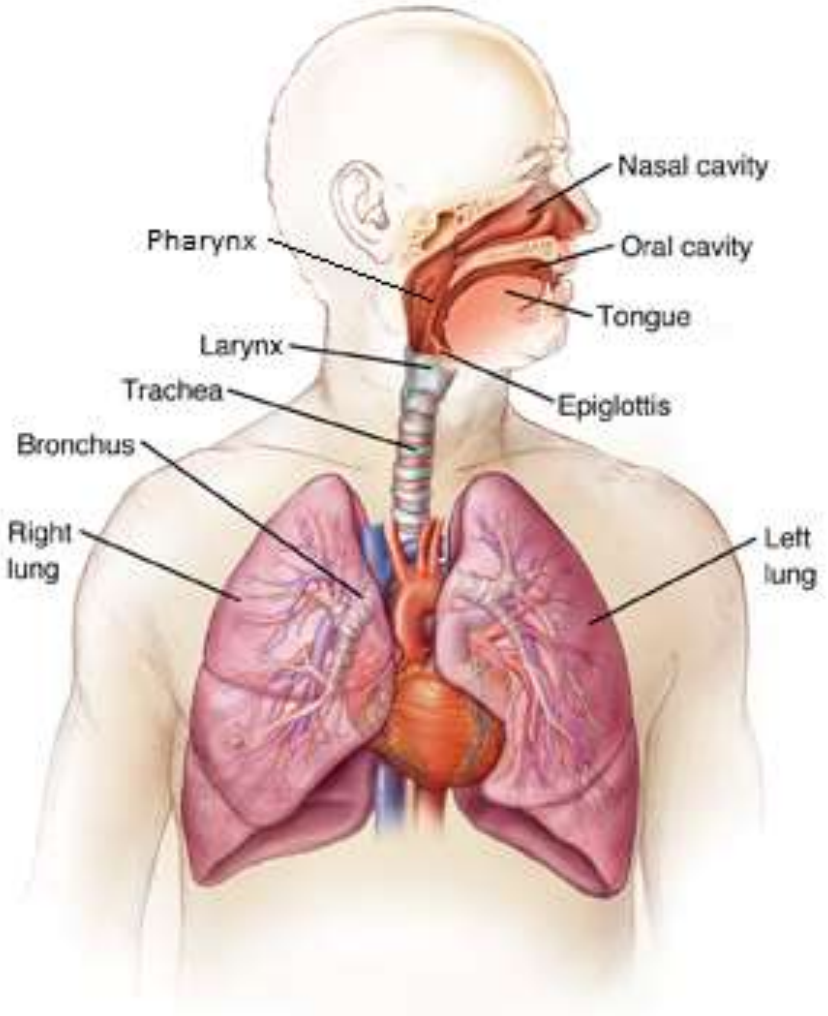

Image adapted from: integrisok.com

Respiration

- Also known as breathing
- Two phases:
  - Inhalation
    - Also known as inspiration
    - Occurs when diaphragm lowers, which causes increased volume/space in thoracic cavity. This results in negative pressure in the lungs compared to the atmospheric pressure outside the lungs; therefore, air rushes from outside the body into the oral and nasal cavities, down the trachea, and into the lungs.
  - Exhalation
    - Also known as expiration
    - The decrease in the volume/space of thoracic cavity after inhalation results in positive pressure in the lungs. If the airway is open, air will rush out of the lungs (up the trachea and out the oral and nasal cavities) in order to equalize the outside and inside pressure.

Phonation

- The act of phonation occurs in the **larynx**, where the vocal cords are housed
- The larynx is also called the “voice box”

- The Larynx is composed of:
  - Cartilages (6)
    - Single cartilages: Epiglottis, thyroid, cricoid
    - Paired cartilages: Arytenoid, corniculate and cuneiform
  - Muscles & Ligaments
    - Support and connect the cartilages of the larynx
    - Form the vocal cords

  - Refer to YouTube videos on Larynx

Phonation

- When air from the lungs is forced through closed vocal cords, the vocal cords vibrate and phonation occurs
- The pitch of sounds produced in the larynx is dependent upon the tension of the vocal cords
  - Elongation and tension of the cords results in faster vibration = higher frequency/pitch
  - Shortening and relaxation of the cords results in slower vibration = lower frequency/pitch
    - Fundamental frequency of male voice=130 Hz
    - Fundamental frequency of female voice=220 Hz
- The loudness of sounds produced in the larynx is dependent upon the speed of air flowing through the glottis (space between the cords).
  - The air speed is greatest when the pressure build-up below the vocal cords (subglottal pressure) is high

Anatomy of the Larynx- Cartilages

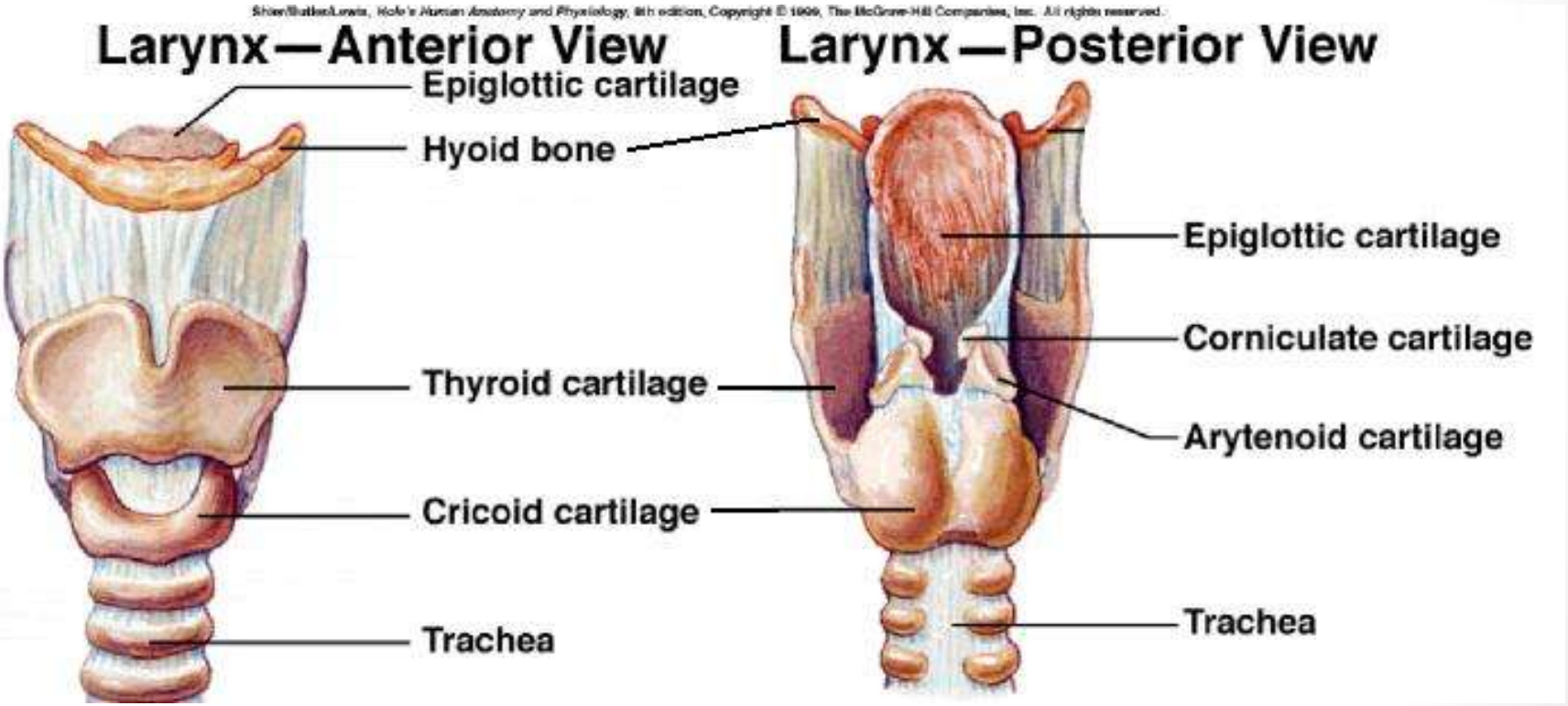

Image from: http://faculty.stcc.edu/AandP

Vocal Cords

- Also referred to as vocal folds
- Housed within the larynx
- Attached anteriorly to the thyroid cartilage and posteriorly to the arytenoid cartilages
  - Closed when we swallow to protect our airway
  - Open when we are breathing in order to allow air in/out of lungs
  - Vibrate open and closed during phonation

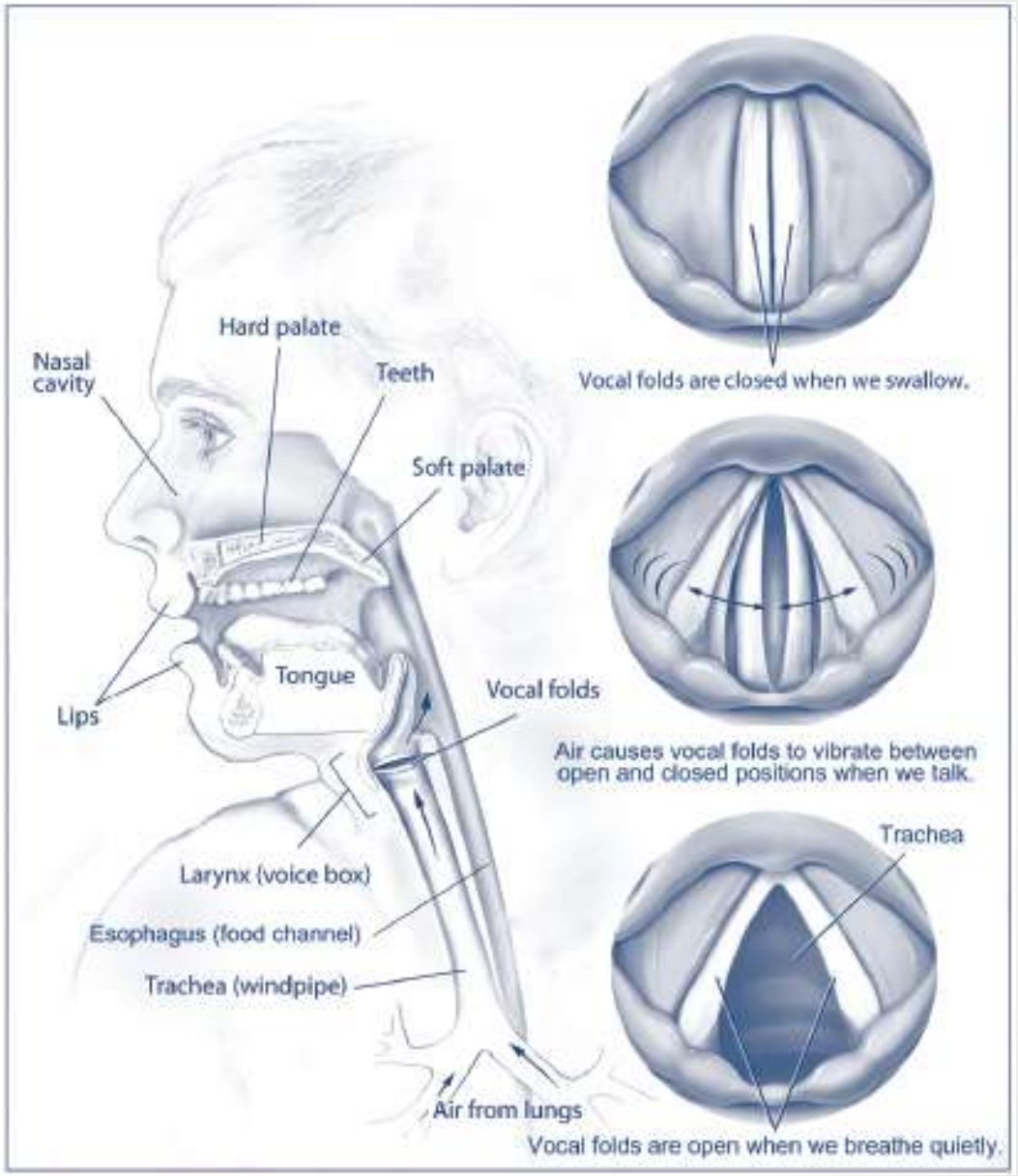

Image from: nidcd.nih.gov

Articulation

- Tongue
- Lips
- Teeth
- Alveolar ridge (gums behind upper teeth)
- Soft Palate
- Hard Palate
- Velum/uvula

- The variable action of the tongue on all of the structures listed above results in our ability to articulate different speech sounds

- A **PHONEME** is the technical term for a specific sound of speech
  - Phonemes are either vowels or consonants

Vowels

- Vowel sounds
  - There are 5 vowels in the English language (a, e, i, o, u), but there are 12 different vowels sounds (i.e. the letter “i” makes different sounds in the words “miss” and “mice”)
  - The articulation of the different vowel sounds depends on:
    - The point of constriction
    - The degree of constriction
    - The degree of lip-rounding
    - The degree of muscle tension
  - Vowel sounds make up 38% of our speech

    - Refer to Zemlin, pp. 300-303

Consonants

- Consonants of English are classified by:
  - Place of articulation
  - Manner of articulation
  - Degree of Voicing
- Consonant sounds make up 62% of our speech
- Refer to Zemlin, pp. 302

Classification of Consonants by Place of Articulation

- **Bilabial**: **both lips** come together (p, b, m, w)
- **Labiodental**: **lower lip** and **upper teeth** make contact (f, v)
- **Dental**: the **tongue** makes contact with the **upper teeth** (-th)
- **Alveolar**: the tip of the tongue makes contact with the alveolar ridge (t, d, s, z, n, l)
- **Palatal**: the tongue approaches the palate (j, r, -sh)
- **Velar:** back of the tongue contacts the velum (k, g, -ng)
- **Glottal:** this is really an unvoiced vowel (h)

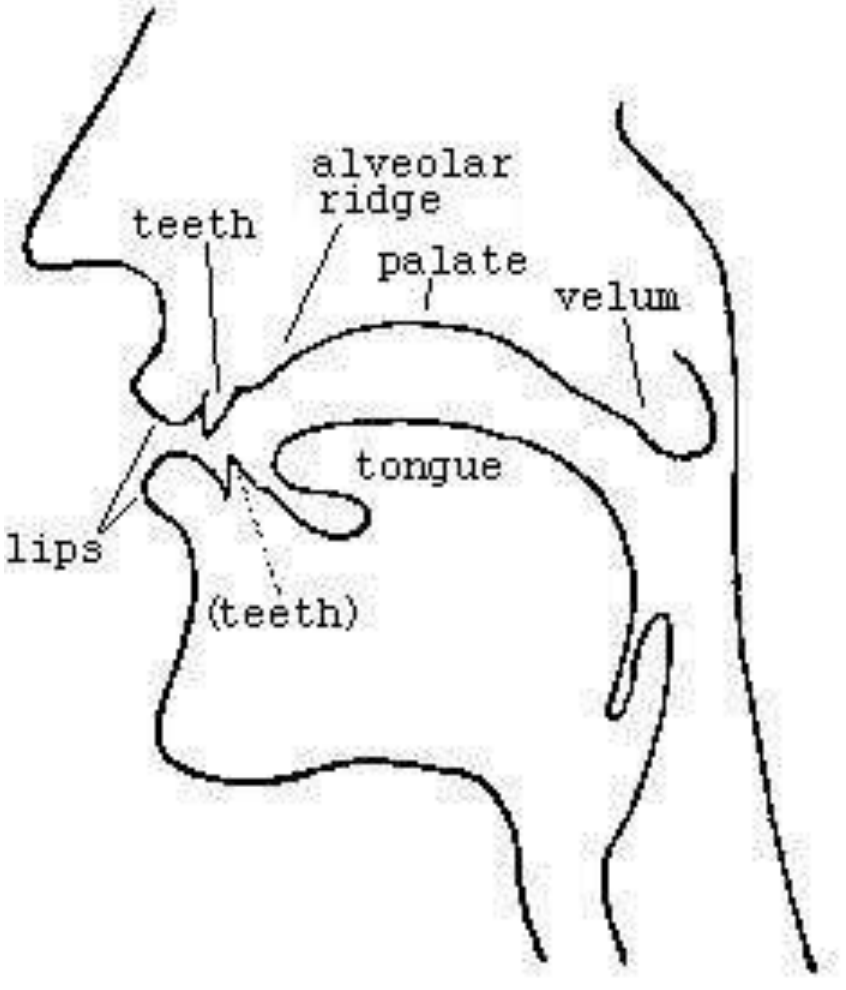

Image from: https://notendur.hi.is

Classification of Consonants by Manner of Articulation

- Manner of articulation refers to the degree of constriction as the consonants begin or end a syllable
  - **Stops** are defined by complete closure of the lips and subsequent release (p, b)
  - **Fricatives** use an incomplete closure of the lips to create turbulent noise (f, s, sh)
  - **Nasals** resonate through the nasal cavity (m, n)
    - ***Hint****: try making these nasal sounds with your nostrils plugged* ☺
  - **Glides** and **Liquids** are produced when the tongue approaches a point of articulation within the mouth but does not come close enough to obstruct or constrict the flow of air enough to create turbulence (l, r, w)

Voiced vs. Voiceless Consonants

- **Voiced** consonants are produced with the vocal cords vibrating
- **Voiceless** consonants are produced with the vocal cords open
  - **Example**
    - The sounds /f/ and /v/ are both labiodental fricatives; however, /f/ is voiceless and /v/ is voiced

Resonance

- Dependent upon the size and shape of the:
  - Vocal Tract
  - Oral Cavity
  - Nasal Cavity

- The resonant frequency of each of our voices will differ depending on the size and shape of the structures above, much like how the resonance of a cello or bass differs from a guitar, which differs from a ukelele.