Speech Production

Outline

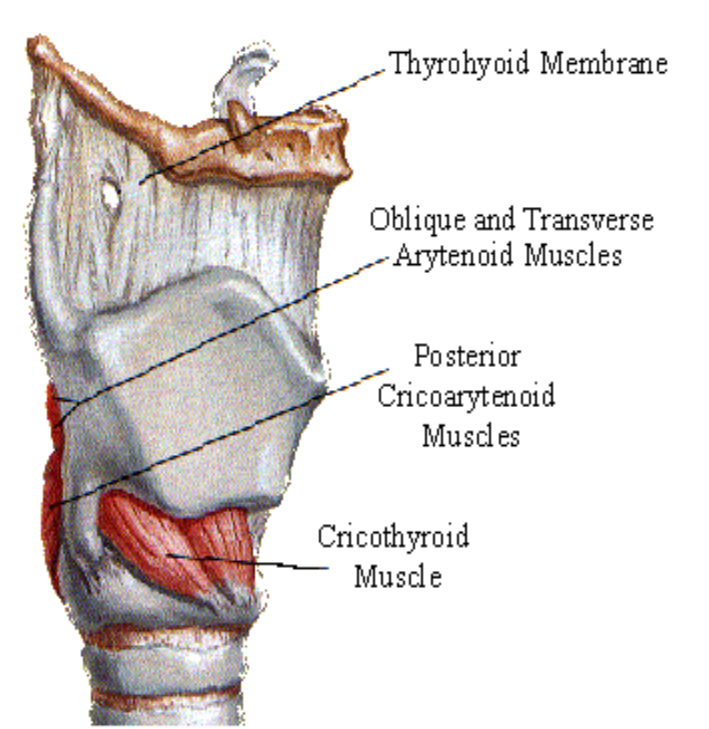
- Respiration
- Phonation
- Articulation
- Organs of speech

Respiration

- For speech we need air
- Most speech sounds require the air going out of our mouth (or nose), these are egressive sounds.
- How do we push the air out?
  - Diaphragm & intercostal muscles affect the size of the rib cage
  - Controlled way, inspiratory and respiratory muscles

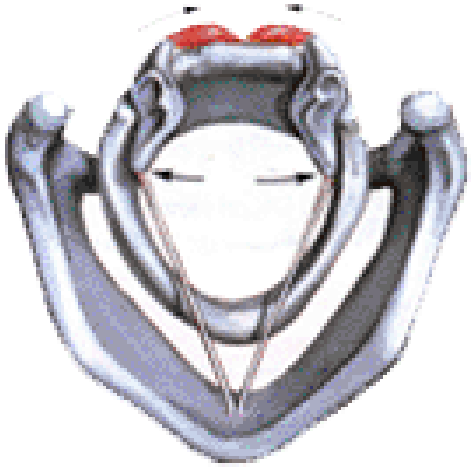
Phonation

- Lungs → bronchi → trachea → larynx
- Phonation occurs when the body of air reaches the vocal folds (chords) that are located in the larynx
- Movie (seminar)

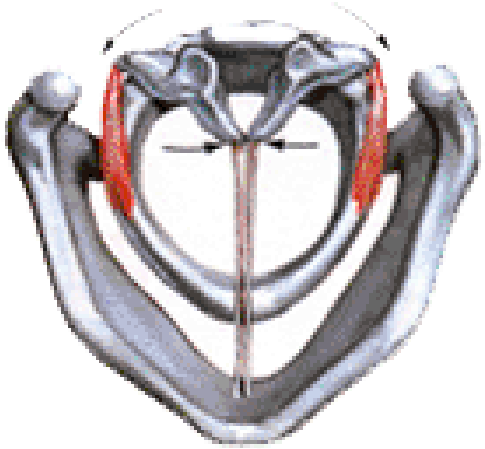


What makes vocal folds move?

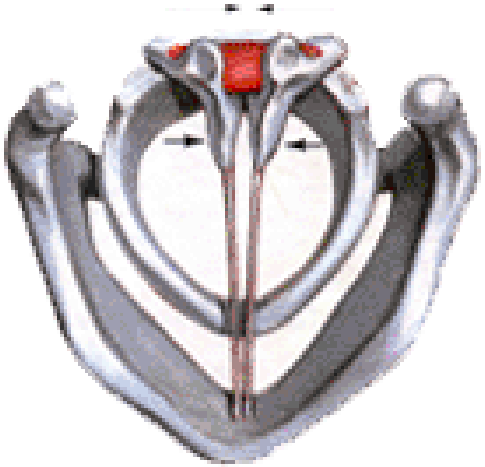
- This is not a voluntary movement
  - Recall that VF open and close some 100-400 times per second
- Aero-dynamics and Bernouli
  - Relationship between air pressure and speed of air molecules: the faster they move, the lower the pressure
  - Subglottal pressure vs. the force pushing VF together



Posterior cricoarytenoid muscle
Abduction of vocal folds



Lateral cricoarytenoid muscles
adduction of vocal folds

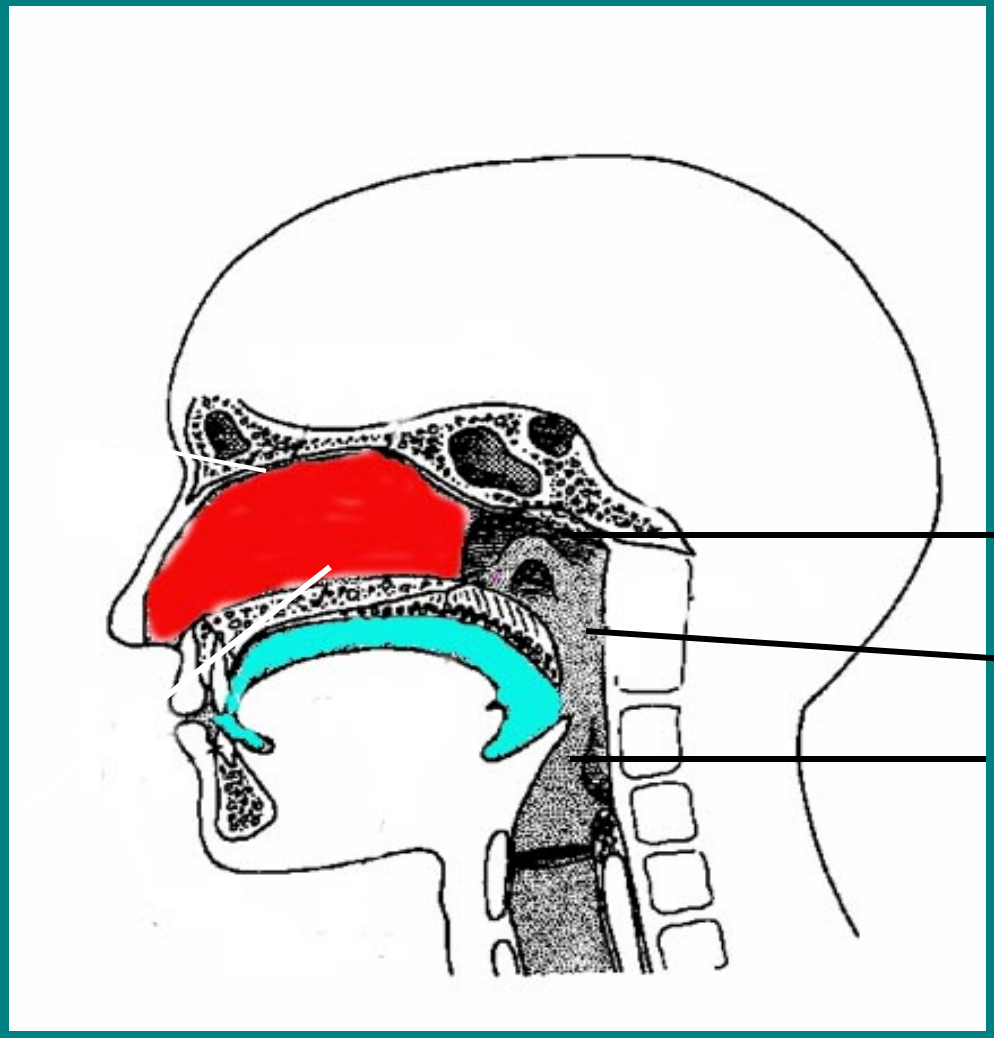


Transverse arytenoid muscle
adduction of vocal folds

Vocalis and thyroarytenoid muscles
shortening (relaxation) of vocal folds

Cavities of Vocal Tract

Nasal cavity



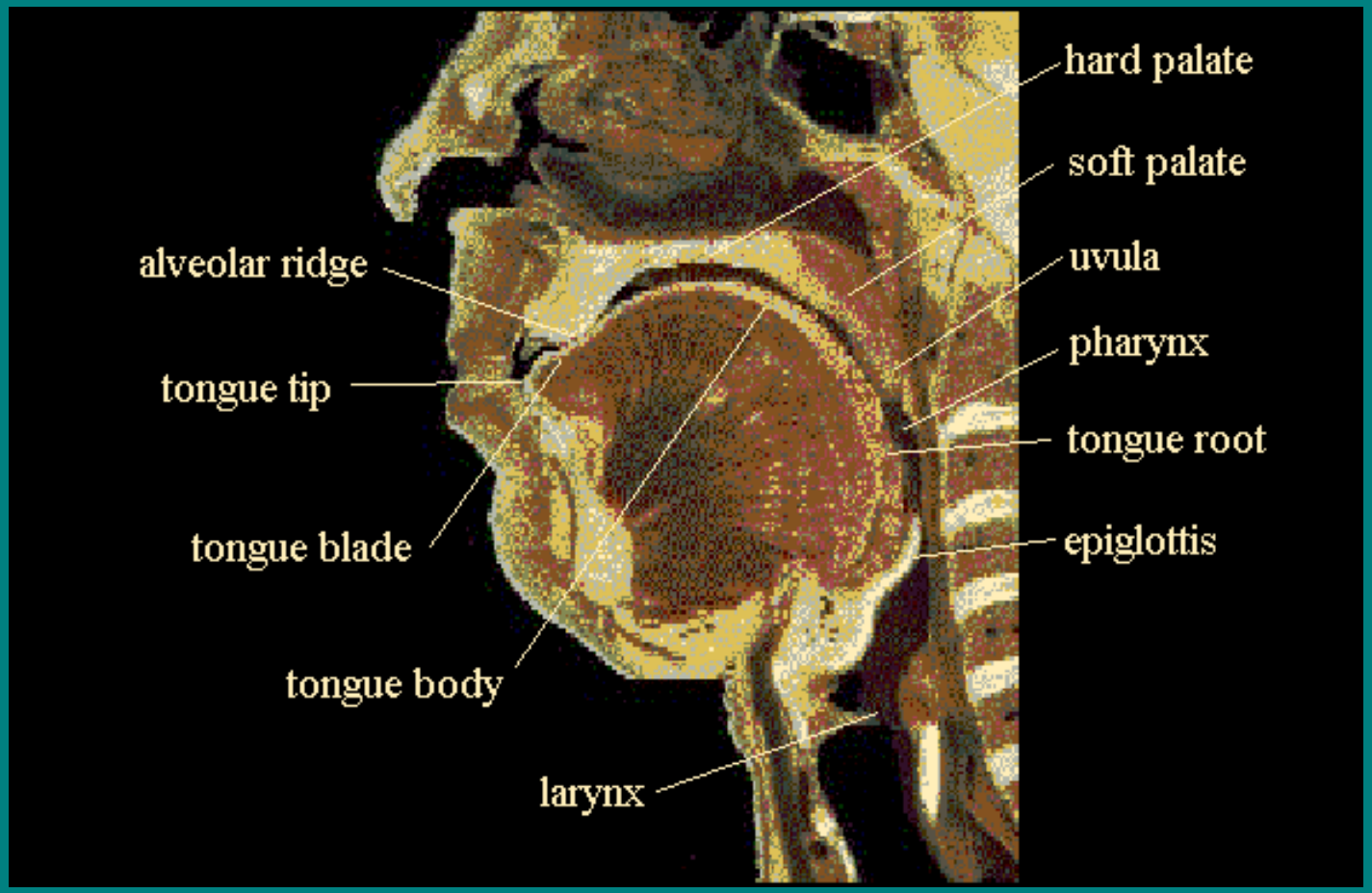
nasopharynx

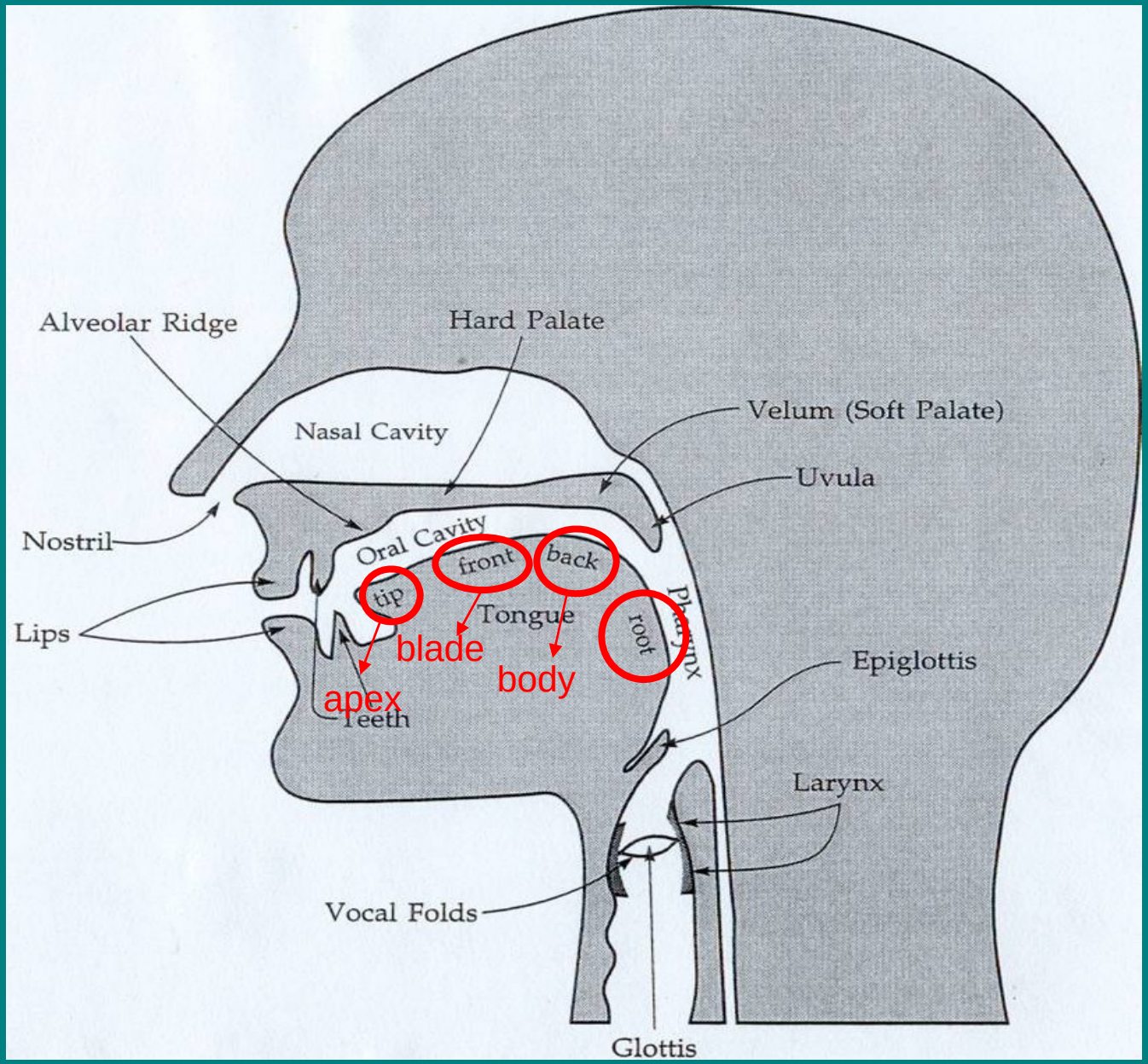
oropharynx

laryngopharynx

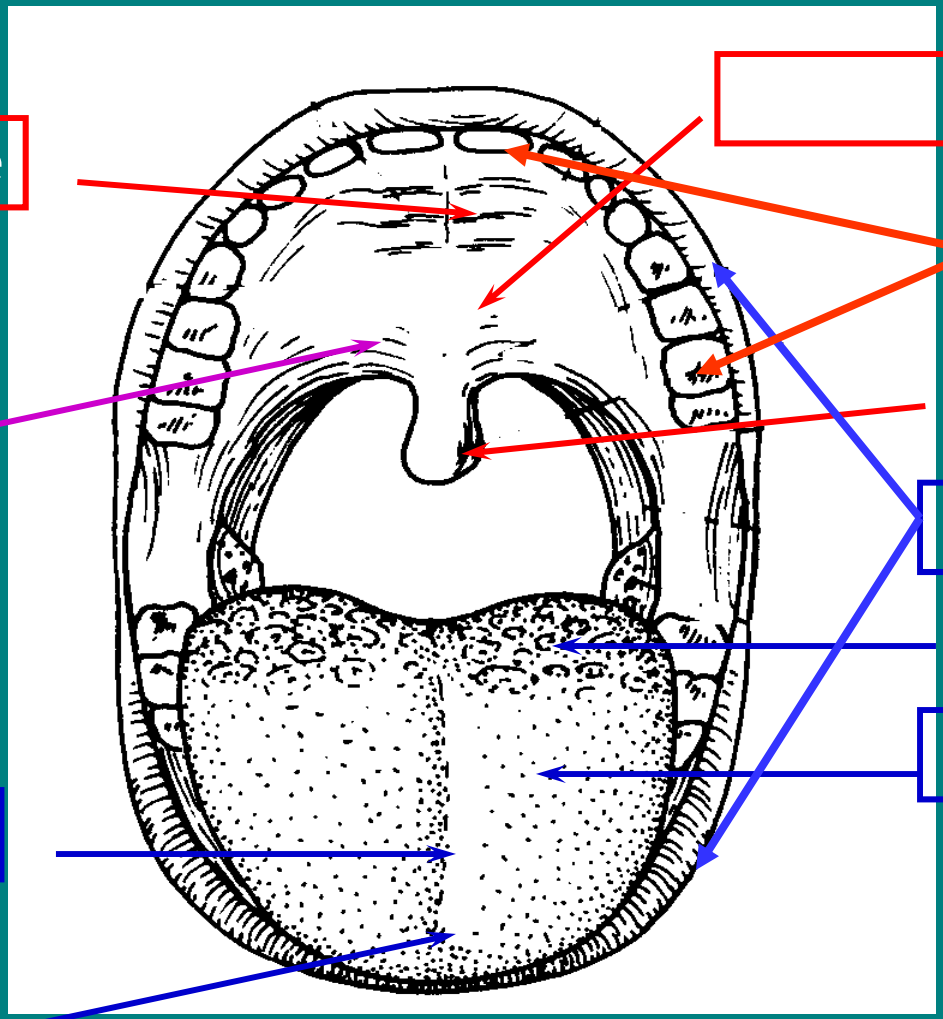
Oral cavity

Vocal tract above larynx




Alveolar Ridge
Hard Palate
Nasal Cavity
Velum (Soft Palate)
Uvula
Nostril
Oral Cavity
front
back
tip
Tongue
root
Pharynx
Lips
blade
body
apex
Teeth
Epiglottis
Larynx
Vocal Folds
Glottis

Active and passive articulators



Alveolar Ridge

Hard Palate

Teeth

Velum

Uvula

Lips

Jaw

Tongue Root

Tongue Body

Tongue Blade

Tongue Tip

Passive Articulator	Active Articulator						
	Lower Lip	Tongue Tip	TongueBlade	Tongue body	Tongue back	Tongue root	Vocal Folds
Upper Lip	bilabial	---	---	***	***	***	***
Upper Front Teeth	labio-dental	(apico-) dental	(lamino-) dental	---	***	***	***
Alveolar Ridge	---	(apico-) alveolar	(lamino-) alveolar	---	***	***	***
Hard Palate	***	retroflex	palato-alveolar	palatal	***	***	***
Soft Palate	***	***	***	---	velar	***	***
Uvula	***	***	***	***	uvular	***	***
Pharynx Wall	***	***	***	***	***	pharyn-geal	***
Vocal Folds	***	***	***	***	***	***	Glottal

Organs of speech

- No unique organs for speech
  - E.g. primates and mammals all have teeth, tongues, lips, vocal chords,…
  - Can higher primates speak?
    - Some limited communication achieved but never using speech (signs or symbols)
- Hence, speech cannot be just “overlaid” on these organs

Evolution…

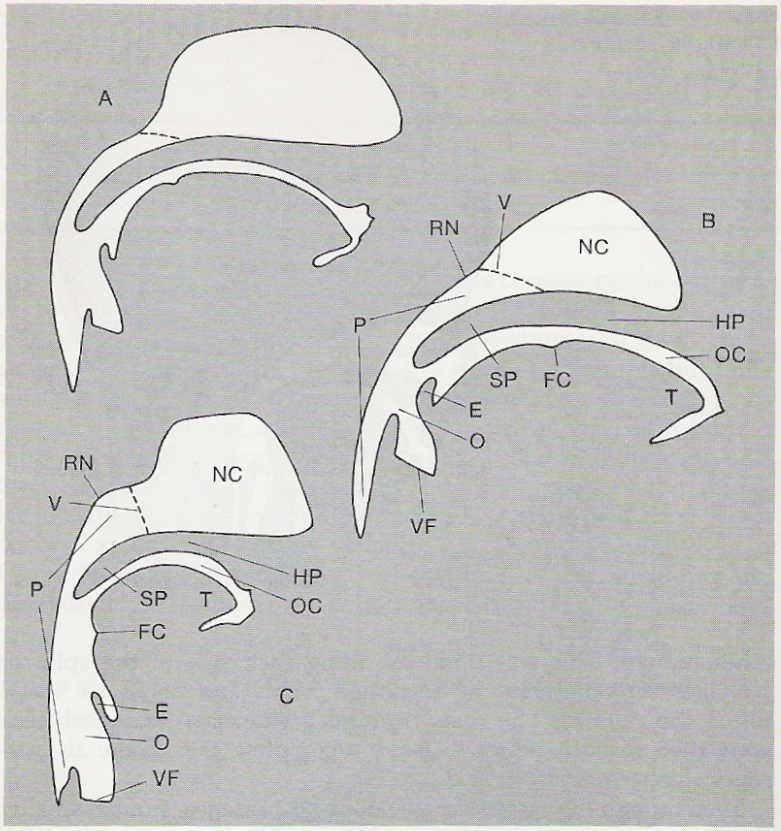


Figure 9-4 Diagrams of the air passages of newborn human (A), adult chimpanzee (B), and adult human (C). The anatomical details that are keyed on the chimpanzee and adult human are as follows: P, pharynx; RN, roof of nasopharynx; V, vomer bone; NC, nasal cavity; HP, hard palate; OC, oral cavity, T, tongue, FC, foramen cecum; SP, soft palate; E, epiglottis; O, opening of larynx into pharynx; VF, level of vocal folds.

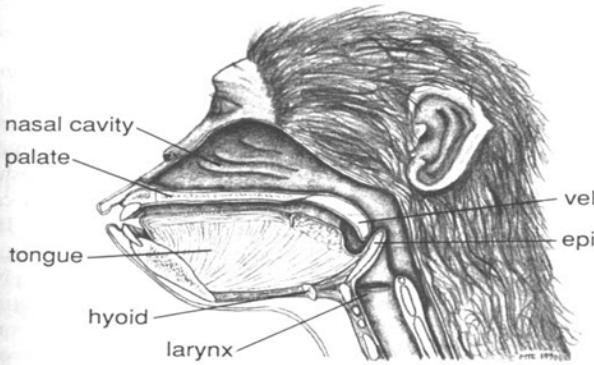


Figure 2–3. A typical nonhuman supralaryngeal airway: a chimpanzee. The tongue is positioned entirely within the oral cavity; the larynx is positioned high, close to the opening to the nose. The epiglottis and velum overlap to form a watertight seal when the larynx is raised, locking into the nose during feeding. The hyoid bone is connected to the larynx, jawbone, and skull by means of muscles and ligaments; it is part of the anatomical system that can raise the larynx.

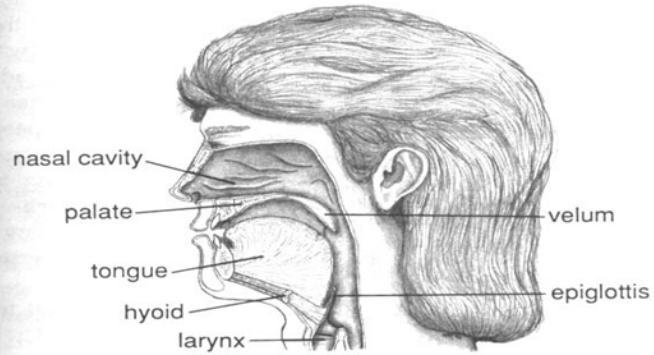


Figure 2–4. The supralaryngeal airway of an adult human being. The low position of the larynx makes it impossible for it to lock into the nose. The tongue has a very different shape from those of all other terrestrial mammals; its posterior contour is almost round in this lateral view and forms both the floor of the oral cavity and the front part of the pharynx.

What happened and why?

- What?
  - Larynx lowered significantly
  - Epiglottis and soft palate cannot close off the mouth cavity
- Why?
  - These changes make our lives more difficult and dangerous!!
    - Possibility of choking, less air intake possible
  - But, they make our speaking much more efficient
    - Our speech apparatus evolved adaptively favoring communicative function over more basic ones (P.Lieberman)