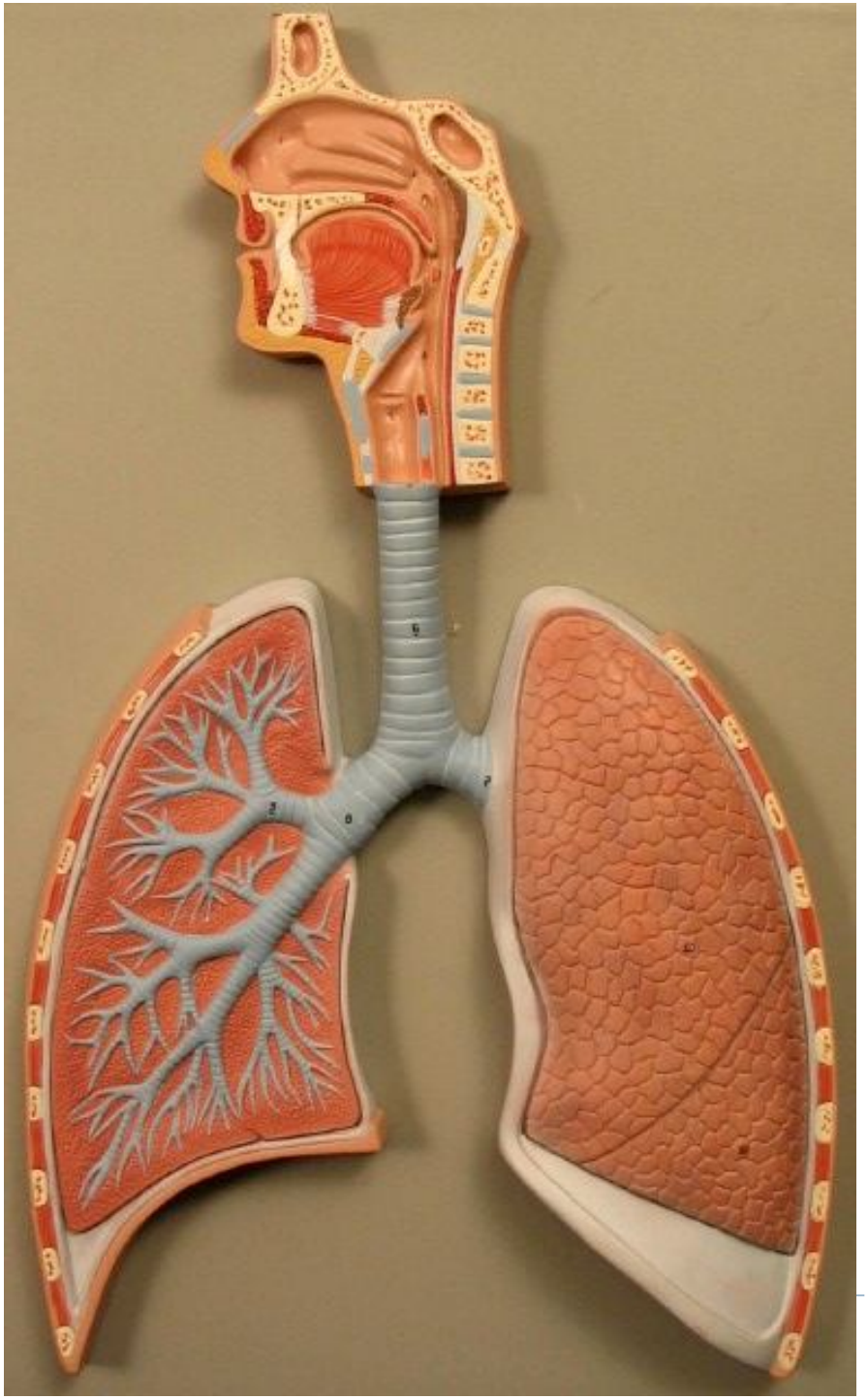
Resp lab

- A) Upper Respiratory Tract (URT)
  - 1) paranasal structures
    - a) external nares
    - b) nasal cavity and septum
    - c) nasal conchae
    - d) nasal meatuses
    - e) olfactory epithelium
    - f) paranasal sinuses
    - g) ciliated pseudostratified epithelium
  - 2) pharynx
    - a) internal nares
    - b) auditory tubes
    - c) oropharynx
    - d) laryngopharynx
- B) Lower Respiratory Tract (LRT)
  - 1) layrnx
    - a) thyroid & cricoid cartilage
    - b) vocal box
    - c) hyoid
  - 2) trachea
    - a) "C" rings of cartilage
    - b) carina
      - i) receptors sensitive to irritants
      - ii) initiates cough reflex
    - c) bronchi
  - 3) lungs (right lung = three lobes; left lung = two lobes)
    - a) pleural membranes
    - b) bronchi
    - c) bronchioles
    - d) terminal bronchioles
    - e) smooth muscles within bronchiole walls
      - i) parasympathetic NS activates (using histamine) bronchiole smooth muscle (constriction)
      - ii) sympathetic NS inhibits (using epinephrine) bronchiole smooth muscle (dilation)
    - f) alveolar ducts
    - g) alveolar sacs
    - h) alveoli
      - i) simple squamous lining
      - ii) septal cells - produce surfactant
      - iii) macrophage (Kuppfer cells) - remove alveolar irritants, debris
      - iv) entire alveolar surface area = 750 sqft
      - v) alveolar surface area site of external respiration

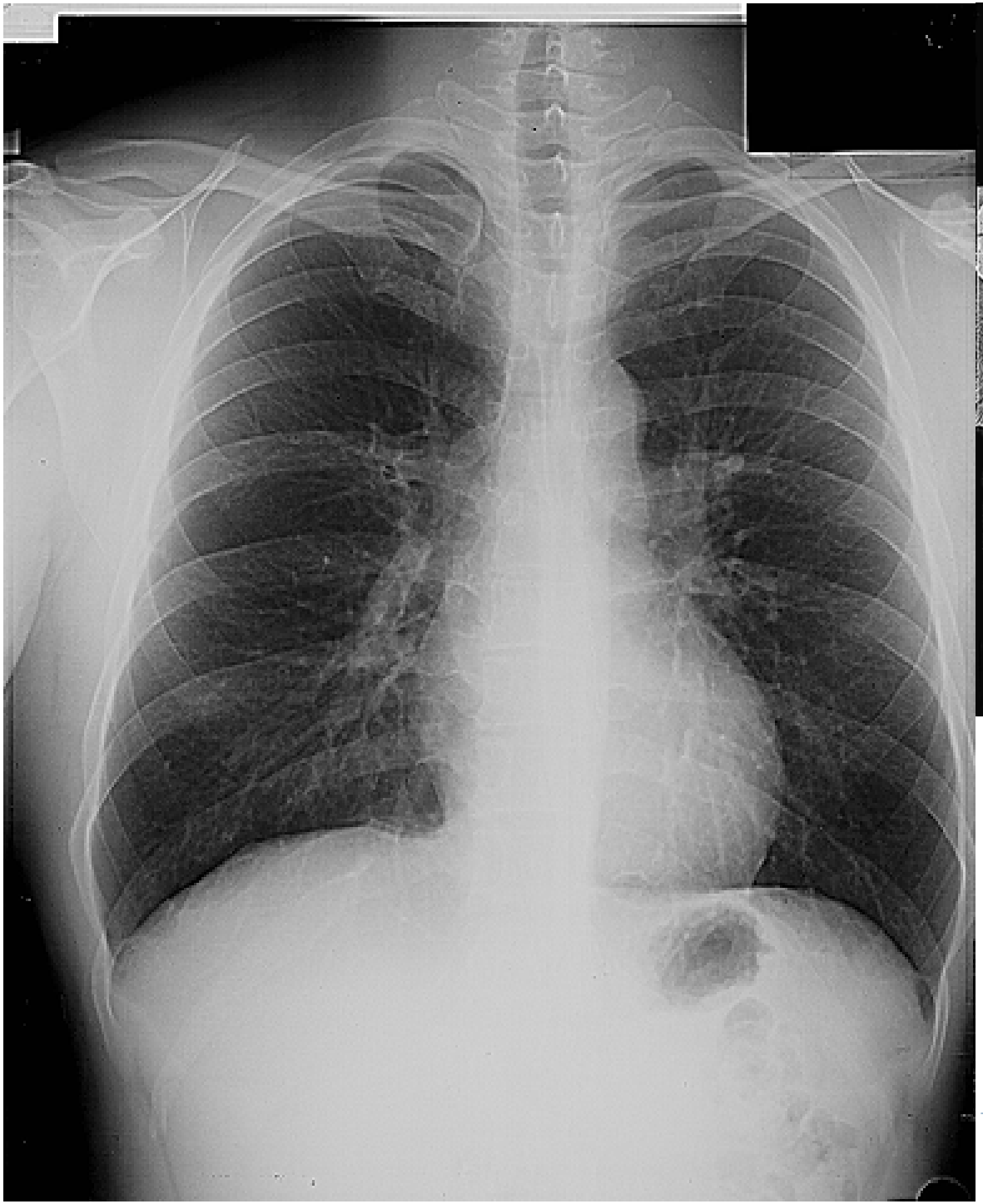


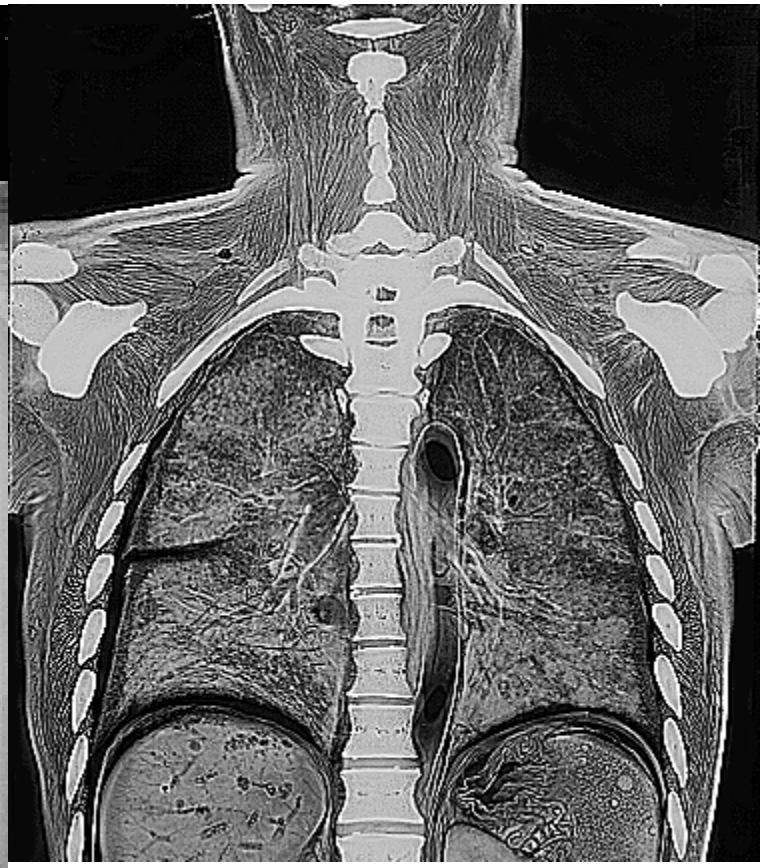
Eupnea - normal breathing
Bradypnea - decreased breathing rate
Dyspnea or *shortness of breath* - sensation of respiratory distress
Hyperaeration/Hyperinflation - increased lung volume
Hyperpnea - faster and/or deeper breathing
Hyperventilation - increased breathing that causes CO_2 loss
Labored breathing - physical presentation of respiratory distress
Tachypnea - increased breathing rate

Organs in the Respiratory System

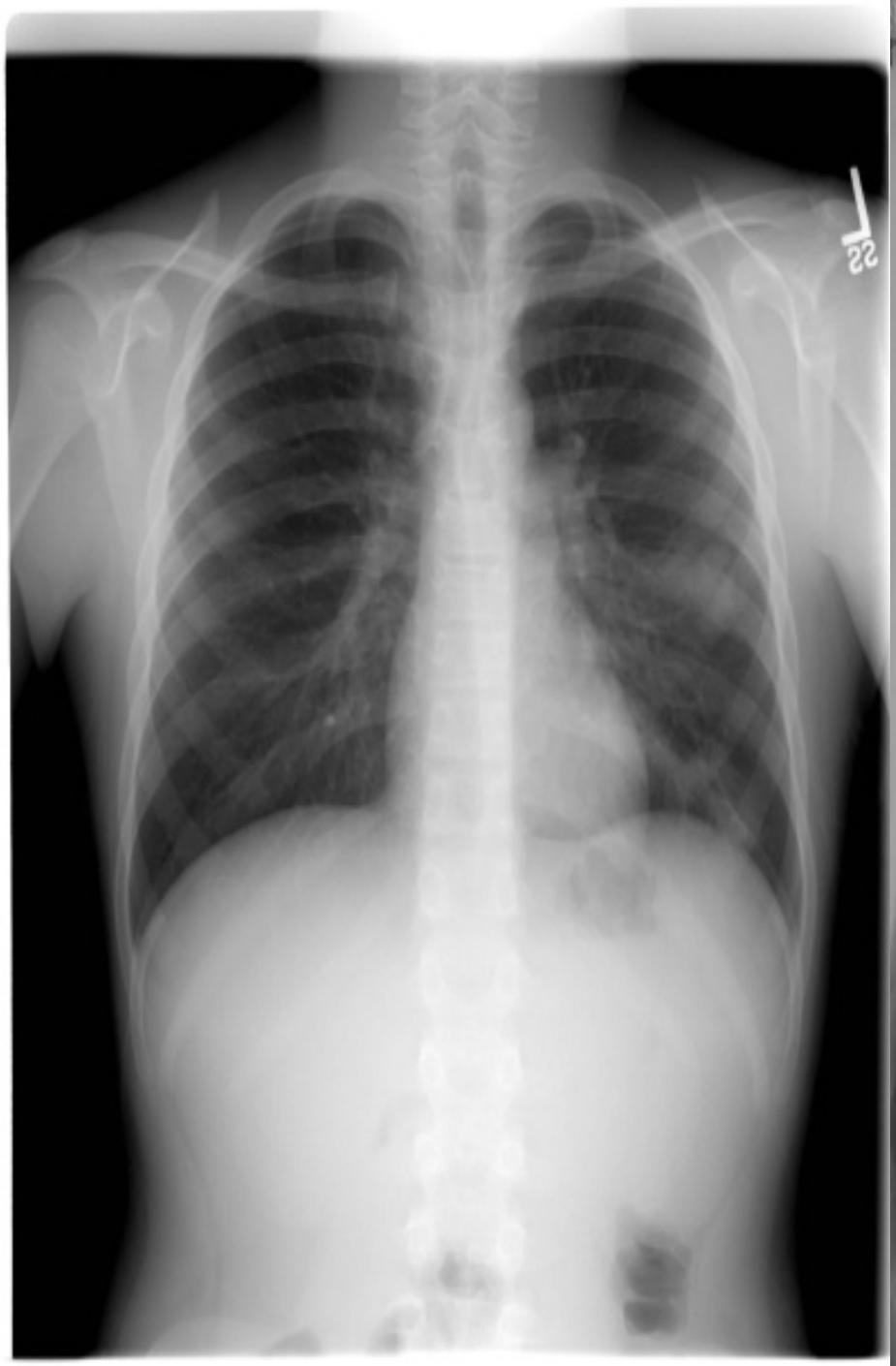
STRUCTURE	FUNCTION
nose / nasal cavity	warms, moistens, & filters air as it is inhaled
pharynx (throat)	passageway for air, leads to trachea
larynx	the voice box, where vocal chords are located
trachea (windpipe)	keeps the windpipe "open" trachea is lined with fine hairs called *cilia* which filter air before it reaches the lungs
bronchi	two branches at the end of the trachea, each lead to a lung
bronchioles	a network of smaller branches leading from the bronchi into the lung tissue & ultimately to air sacs
alveoli	the functional respiratory units in the lung where gases are exchanged

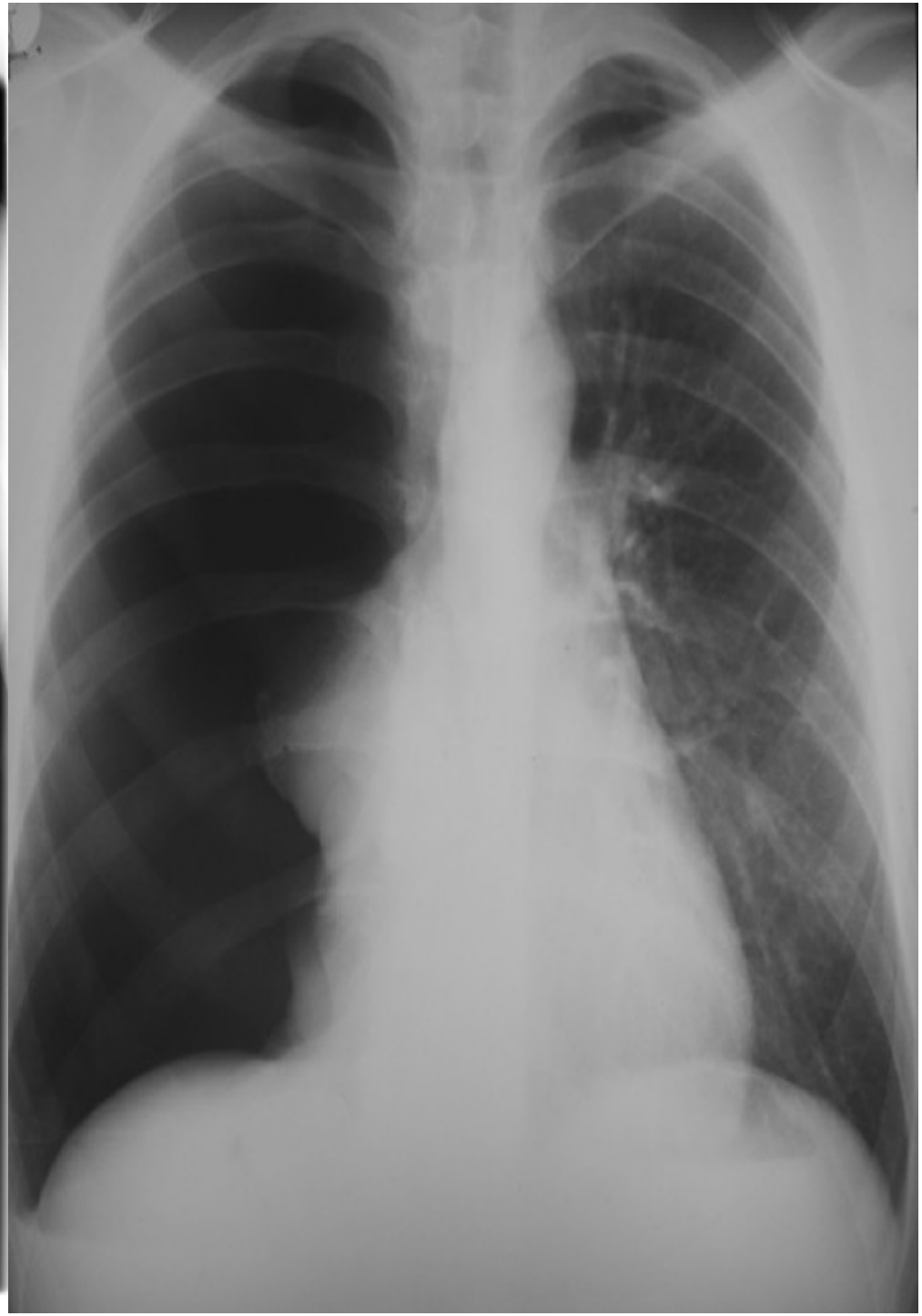
Malfunctions & Diseases of the Respiratory System	
asthma	severe allergic reaction characterized by the constriction of bronchioles
bronchitis	inflammation of the lining of the bronchioles
emphysema	condition in which the alveoli deteriorate, causing the lungs to lose their elasticity
pneumonia	condition in which the alveoli become filled with fluid, preventing the exchange of gases
lung cancer	irregular & uncontrolled growth of tumors in the lung tissue

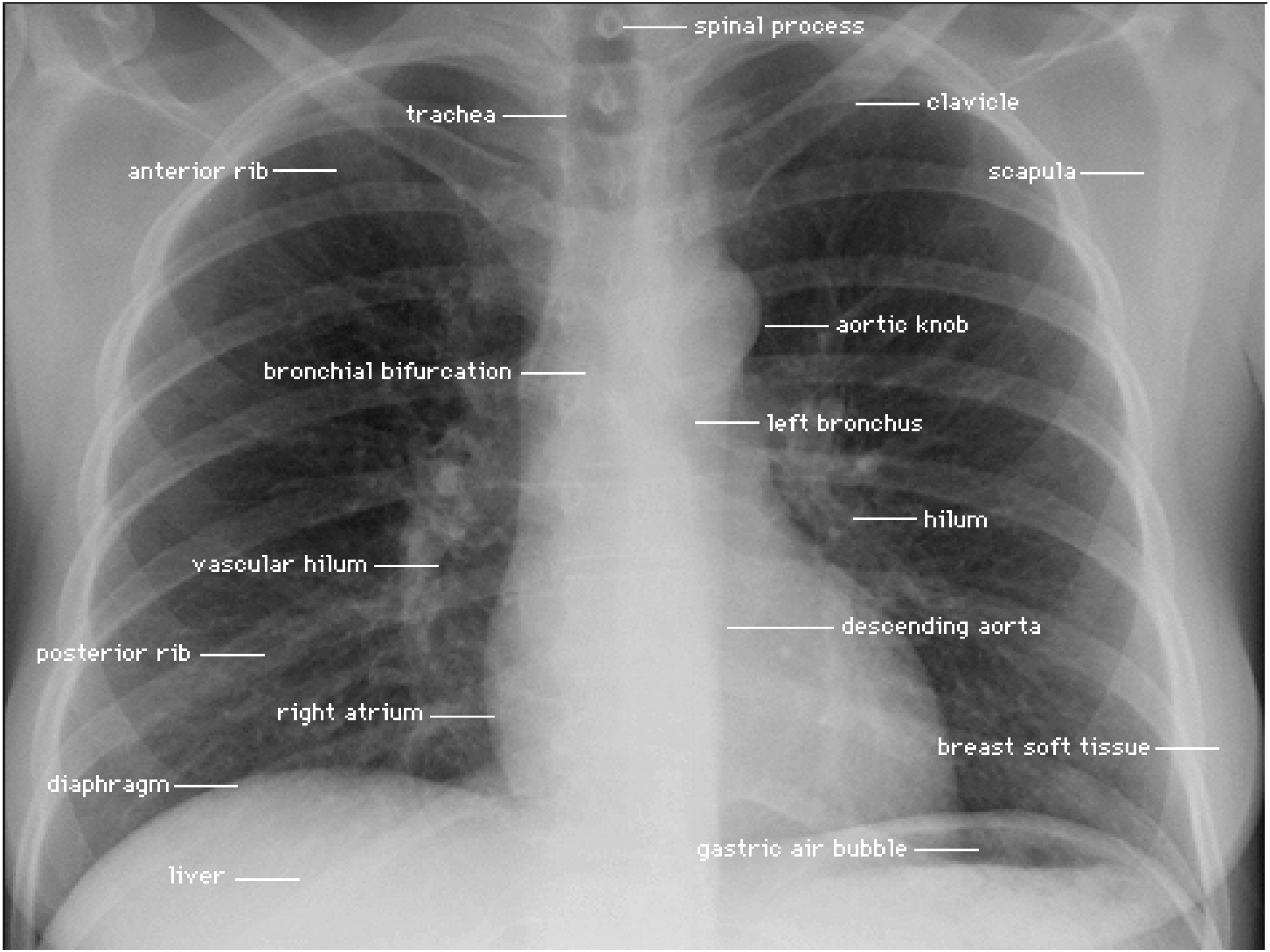


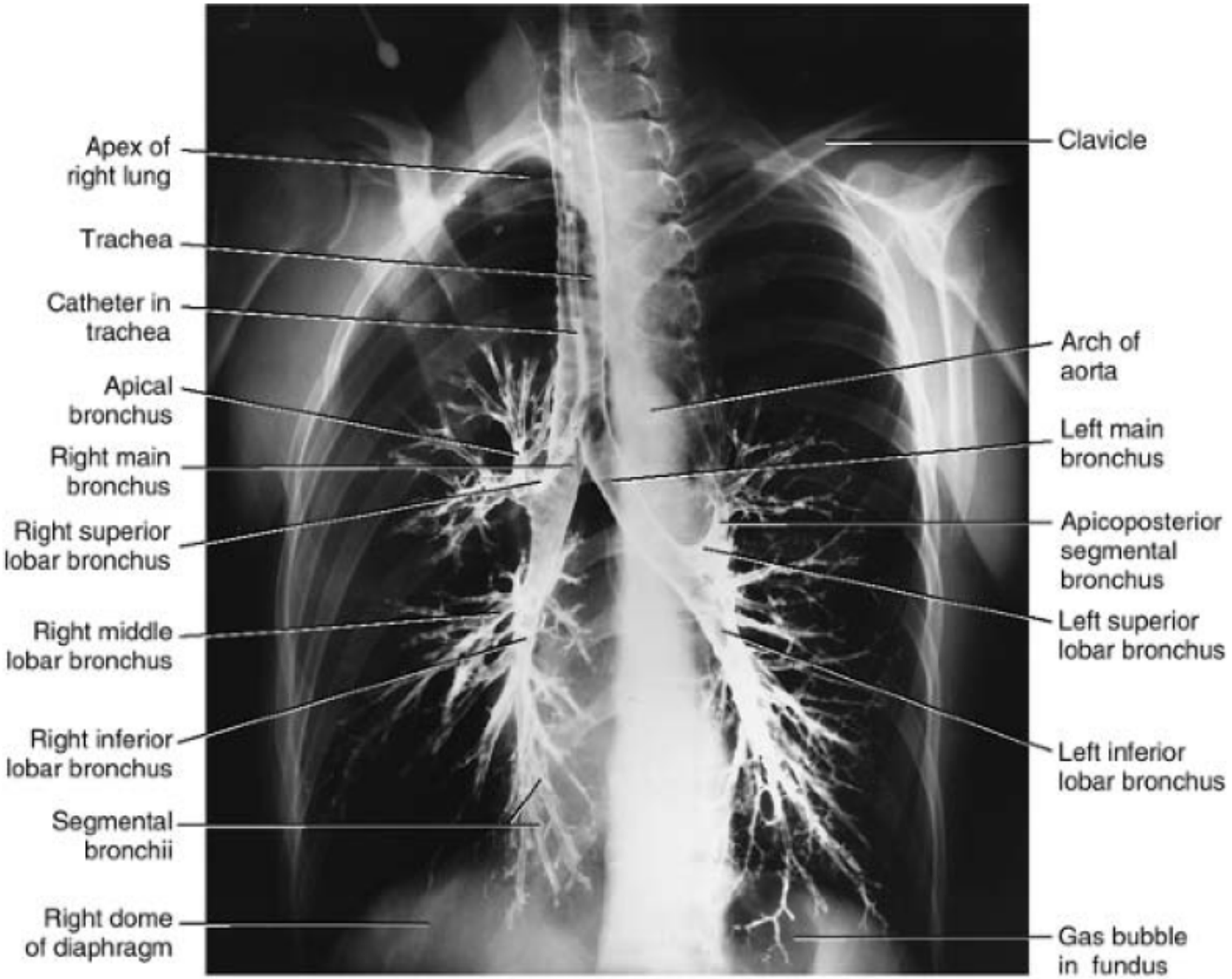


cadaver


22




spinal process
trachea
clavicle
anterior rib
scapula
aortic knob
bronchial bifurcation
left bronchus
hilum
vascular hilum
descending aorta
posterior rib
right atrium
breast soft tissue
diaphragm
gastric air bubble
liver



Posteroanterior view

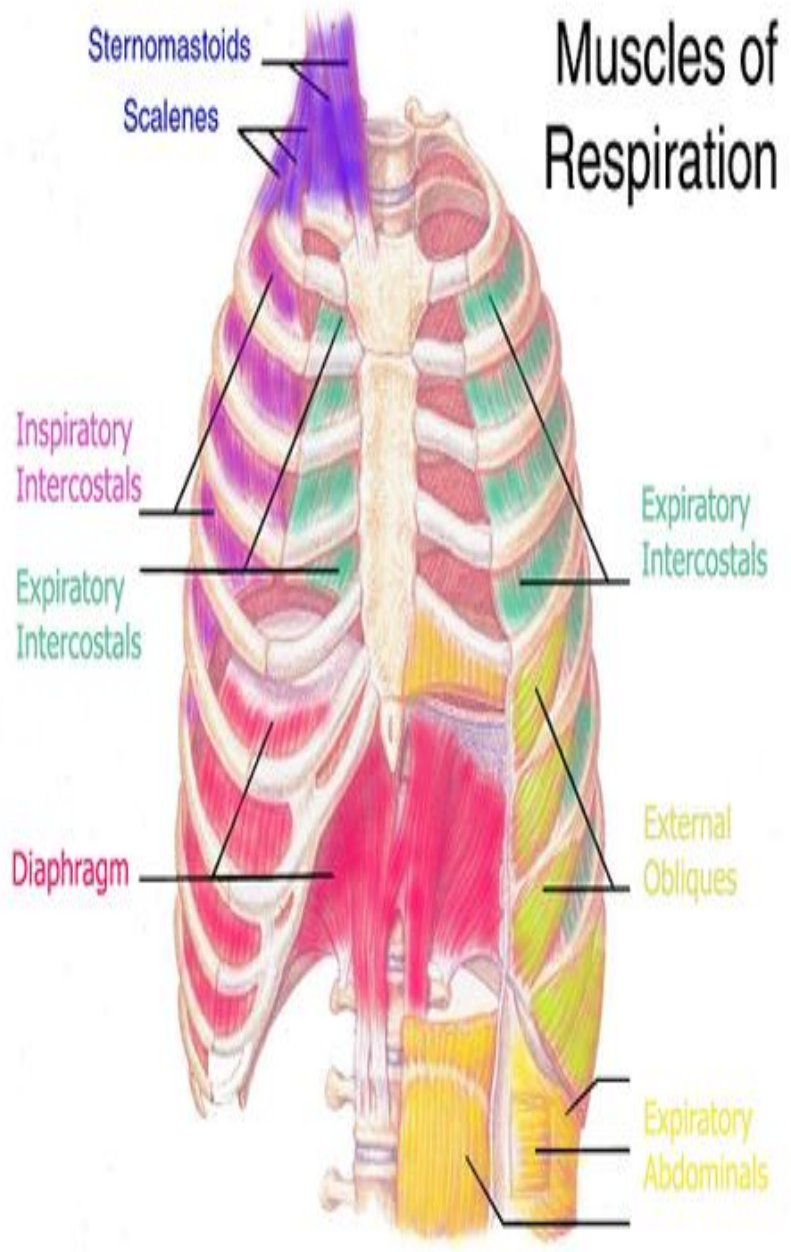
Muscles of Inspiration

- Diaphragm
- External intercostal
- Internal intercostal
- Levator costarum
- Serratus posterior superior
- Sternocleidomastoid
- Scalenus
- Trapezius
- Pectoralis major
- Pectoralis minor
- Serratus anterior
- Subclavius
- Levator scapulae
- Rhomboideus major
- Rhomboideus minor

Muscles of Expiration

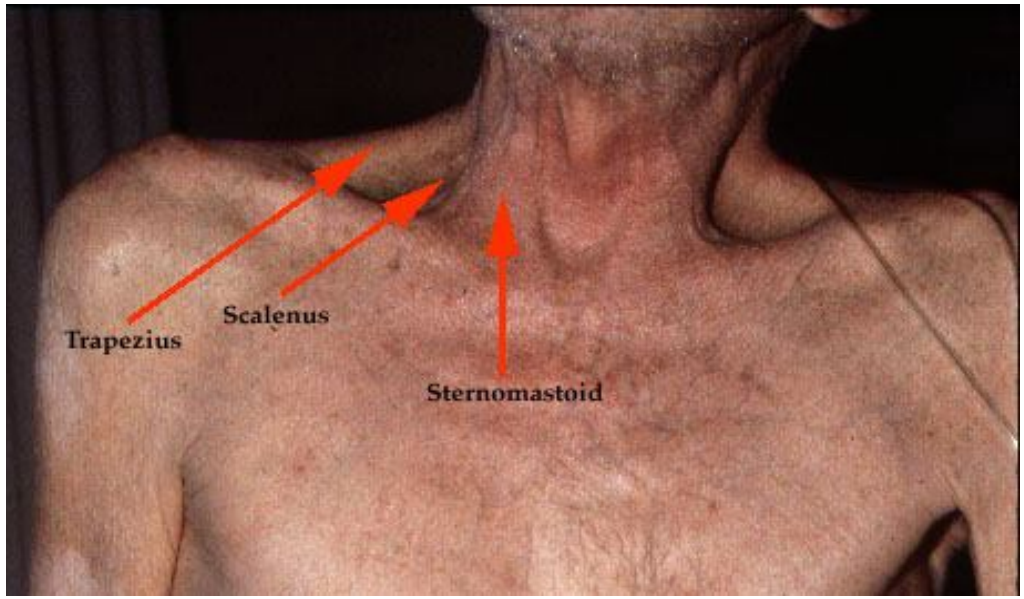
- Internal intercostal
- Transversus thoracis
- Subcostal
- Serratus posterior inferior
- Innermost intercostal
- Latissimus dorsi
- Internal oblique abdominis
- External oblique abdominis
- Rectus abdominis
- Quadratus lumborum

Figure 1.

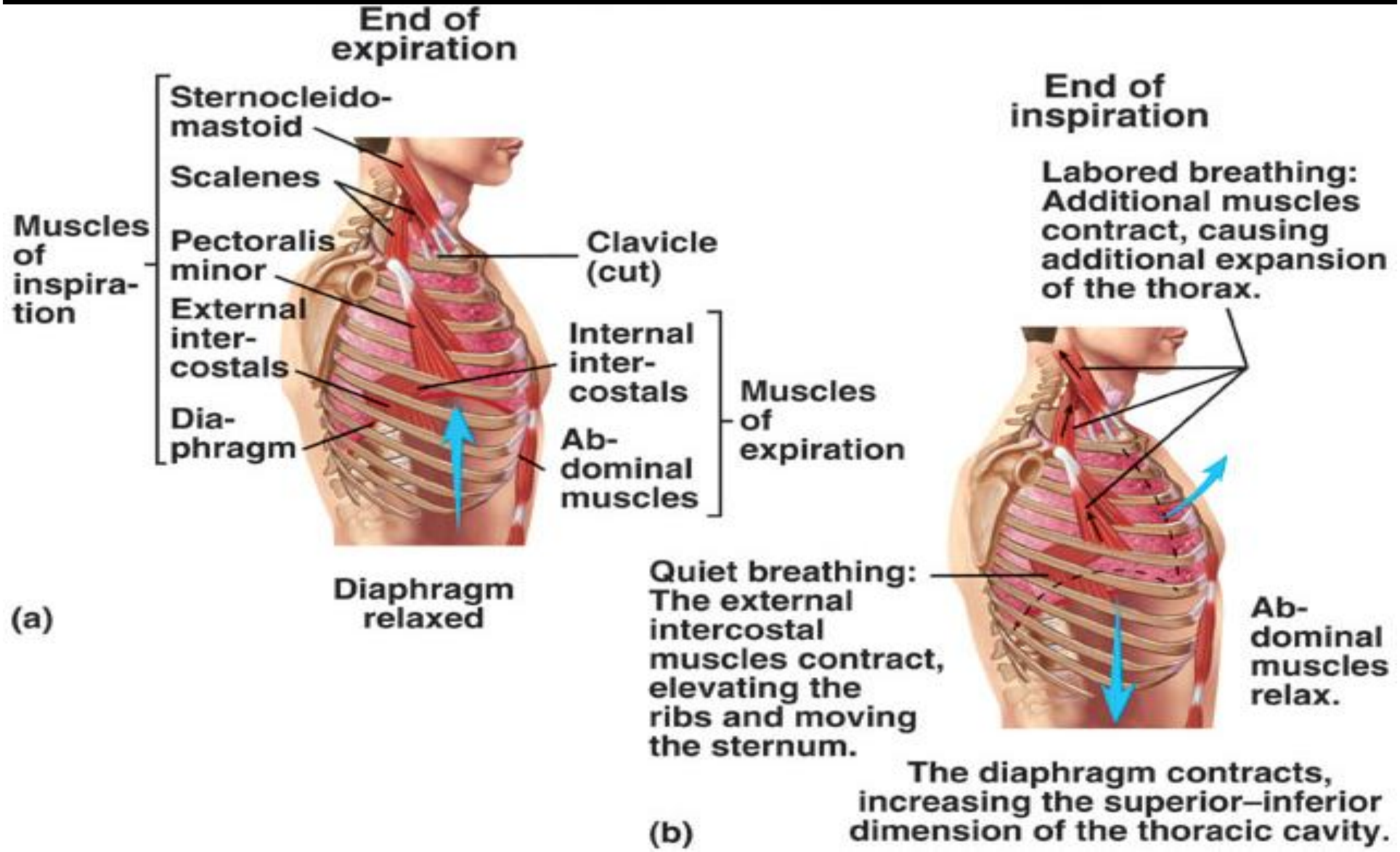


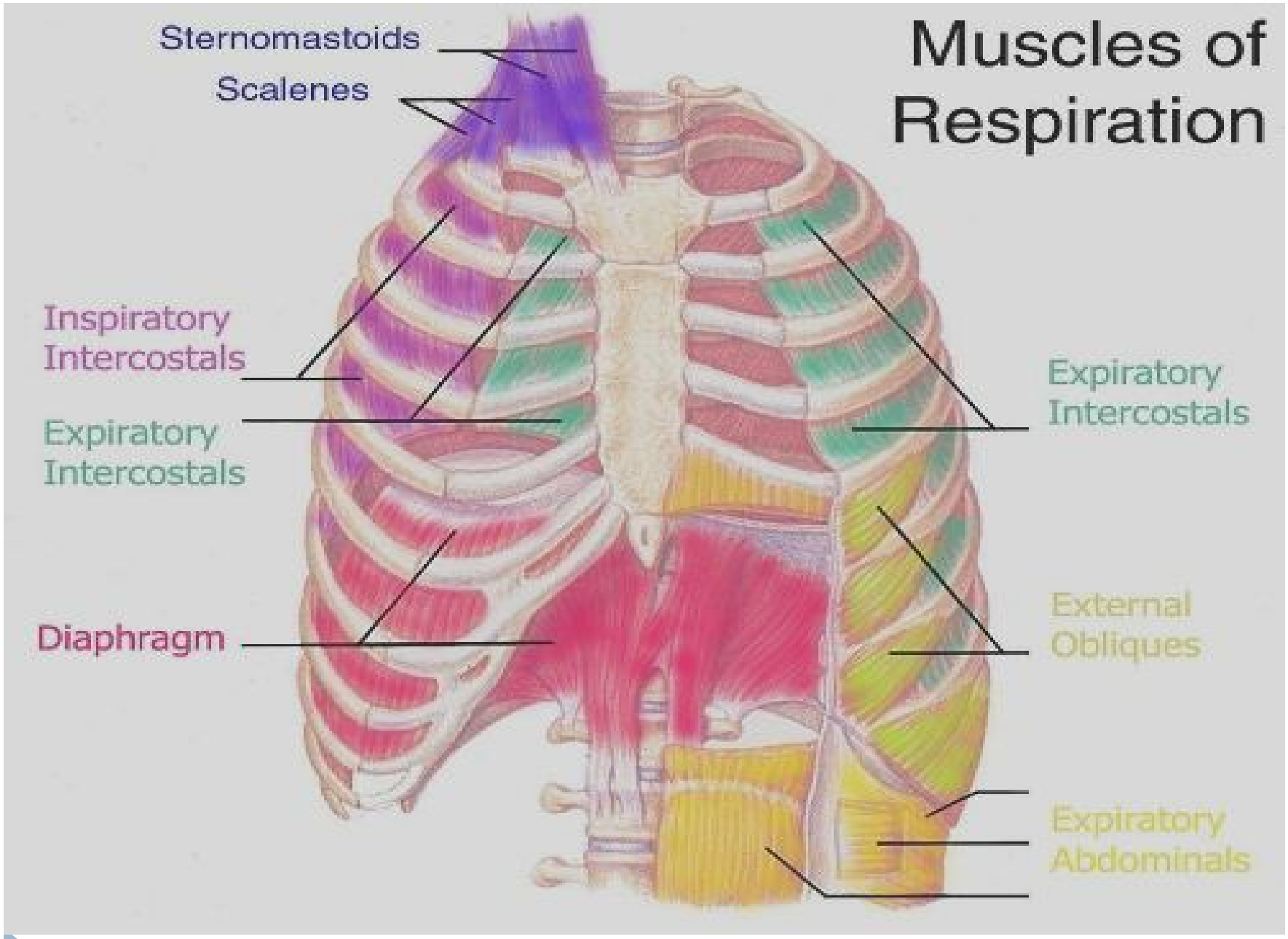
The sternocleidomastoid (elevated sternum) and the scalene muscles (anterior, middle and posterior scalene) are typically considered accessory muscles of breathing

serratus anterior, pectoralis major & minor, upper trapezius, latissimus dorsi, erector spinae (thoracic), iliocostalis lumborum, quadratus lumborum, serratus posterior superior and inferior, levatores costarum, transversus thoracis, subclavius

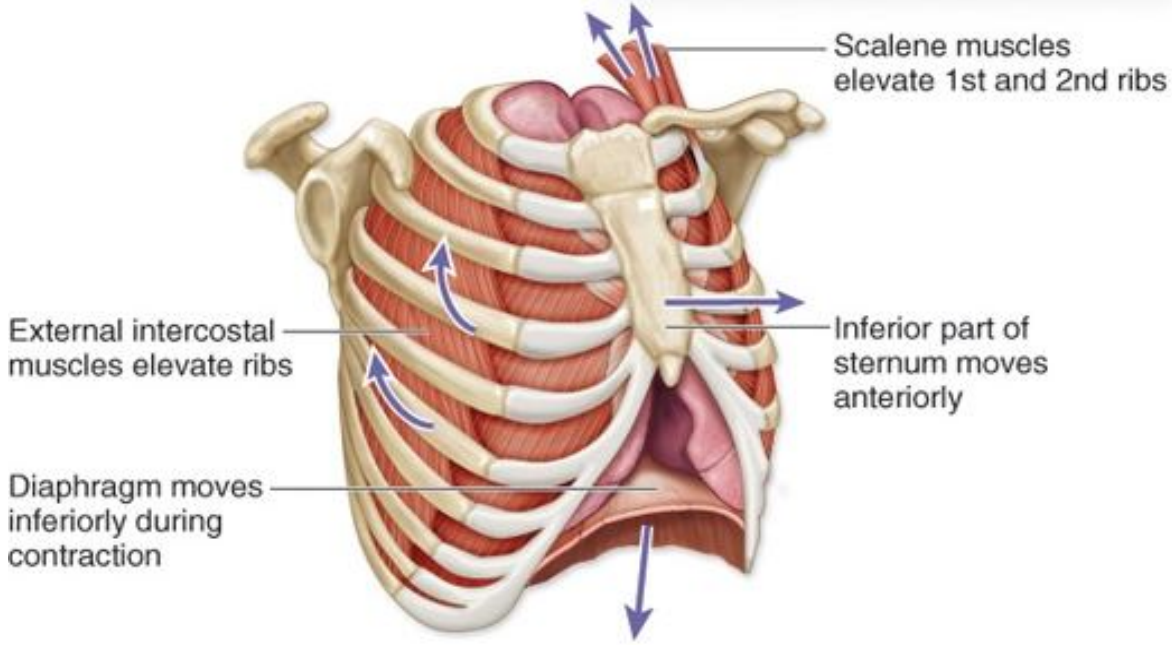


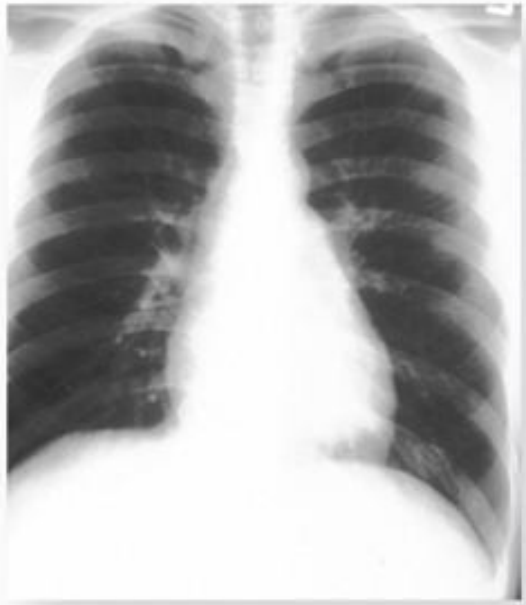
Thoracic Walls
Muscles of Respiration




Muscles of Respiration
Sternomastoids
Scalenes
Inspiratory Intercostals
Expiratory Intercostals
Diaphragm
Expiratory Intercostals
External Obliques
Expiratory Abdominals

Inhalation



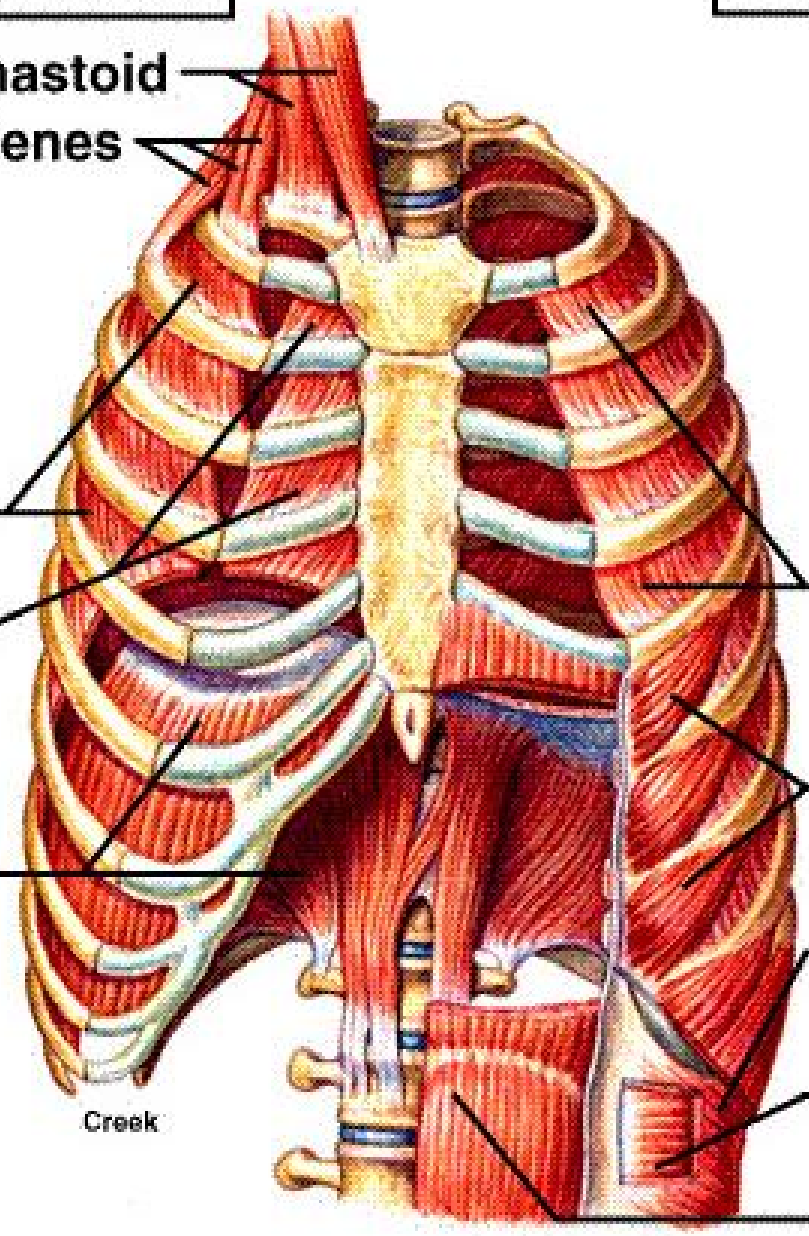


	Sequence of events	Changes in anterior-posterior and superior-inferior dimensions	Changes in lateral dimensions
Inspiration	① Inspiratory muscles contract (diaphragm descends; rib cage rises) ↓ ② Thoracic cavity volume increases ↓ ③ Lungs stretched; intrapulmonary volume increases ↓ ④ Intrapulmonary pressure drops (to –1 mm Hg) ↓ ⑤ Air (gases) flows into lungs down its pressure gradient until intrapulmonary pressure is 0 (equal to atmospheric pressure)		

Muscles Involved in Breathing

Muscles of inspiration

Muscles of expiration



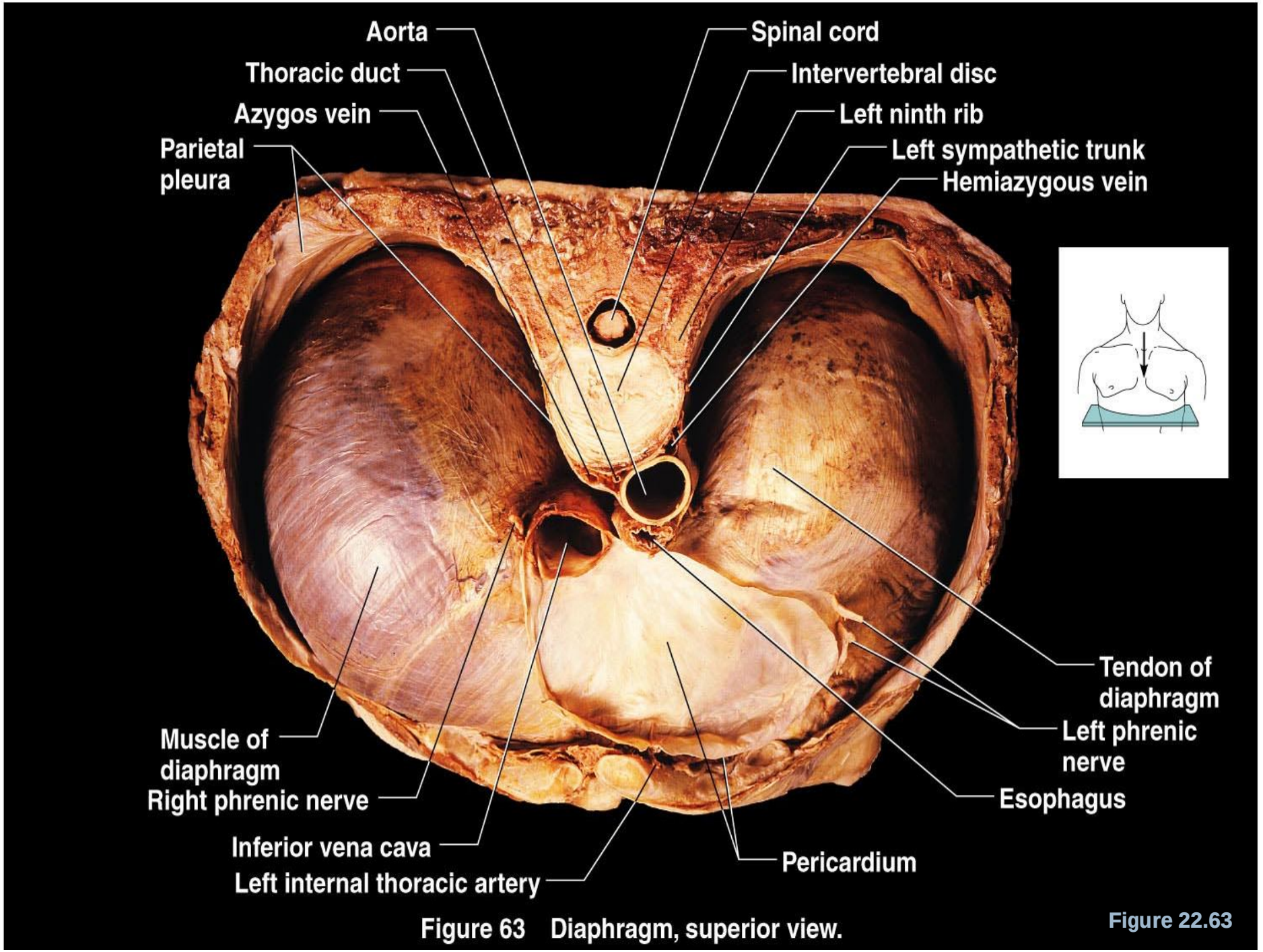
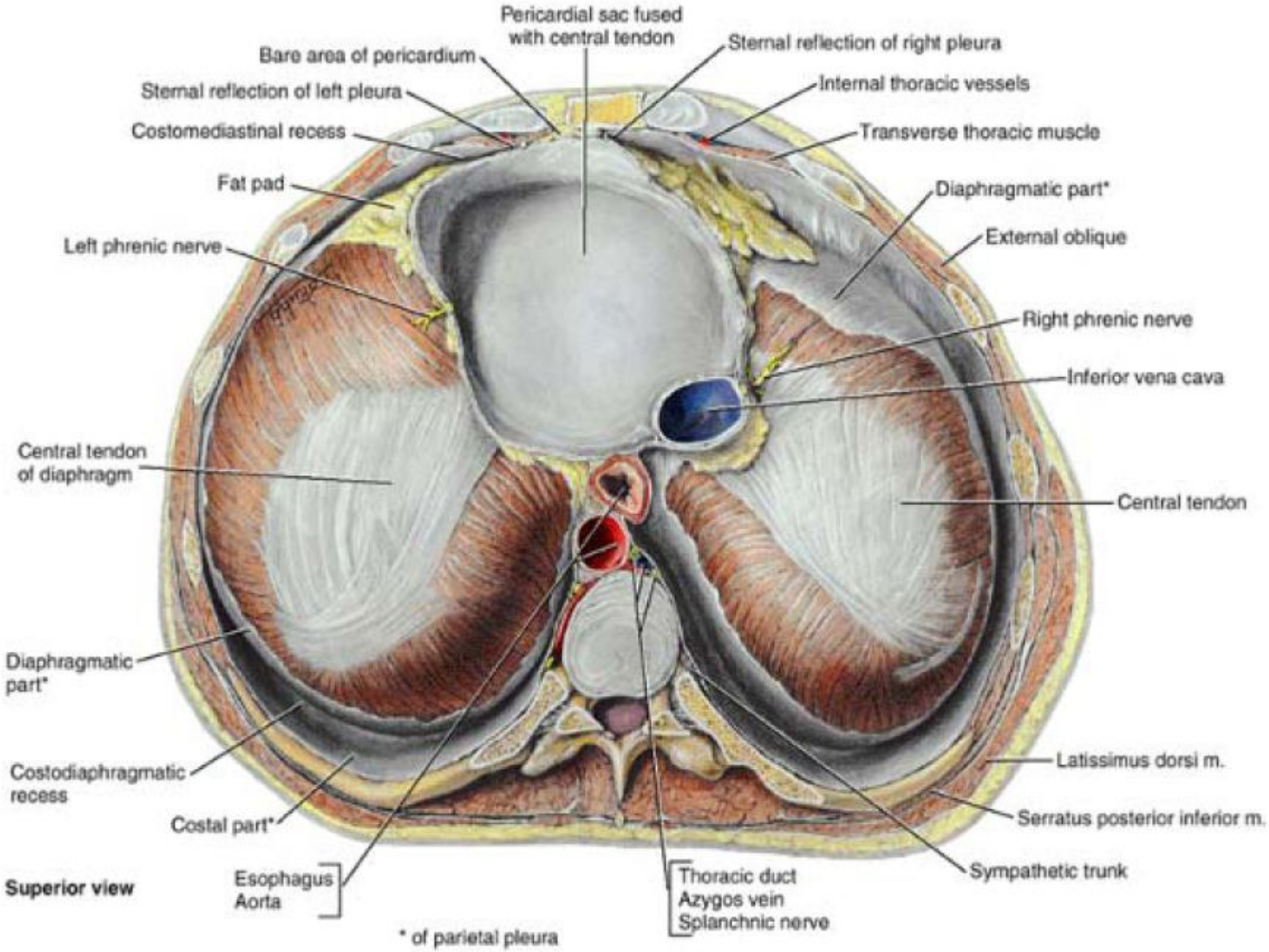
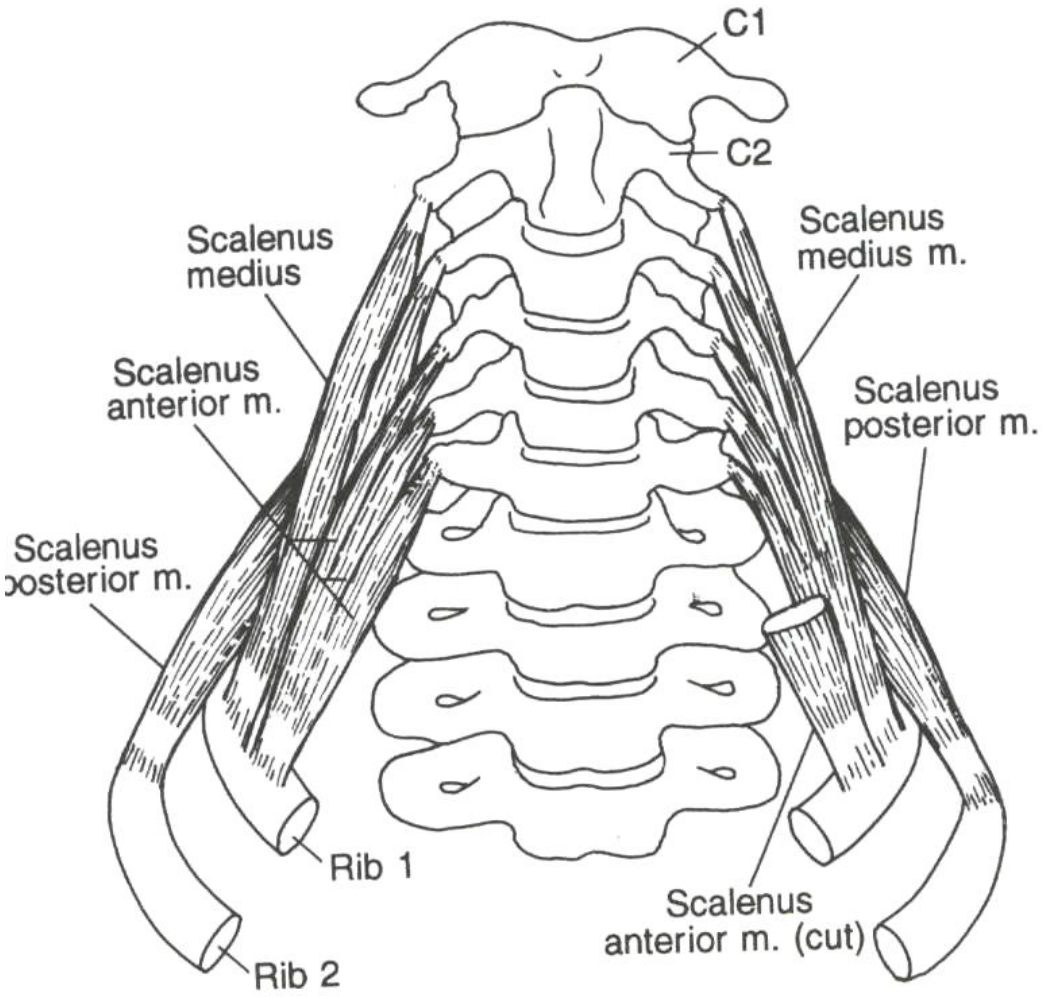


Figure 63 Diaphragm, superior view.

Figure 22.63

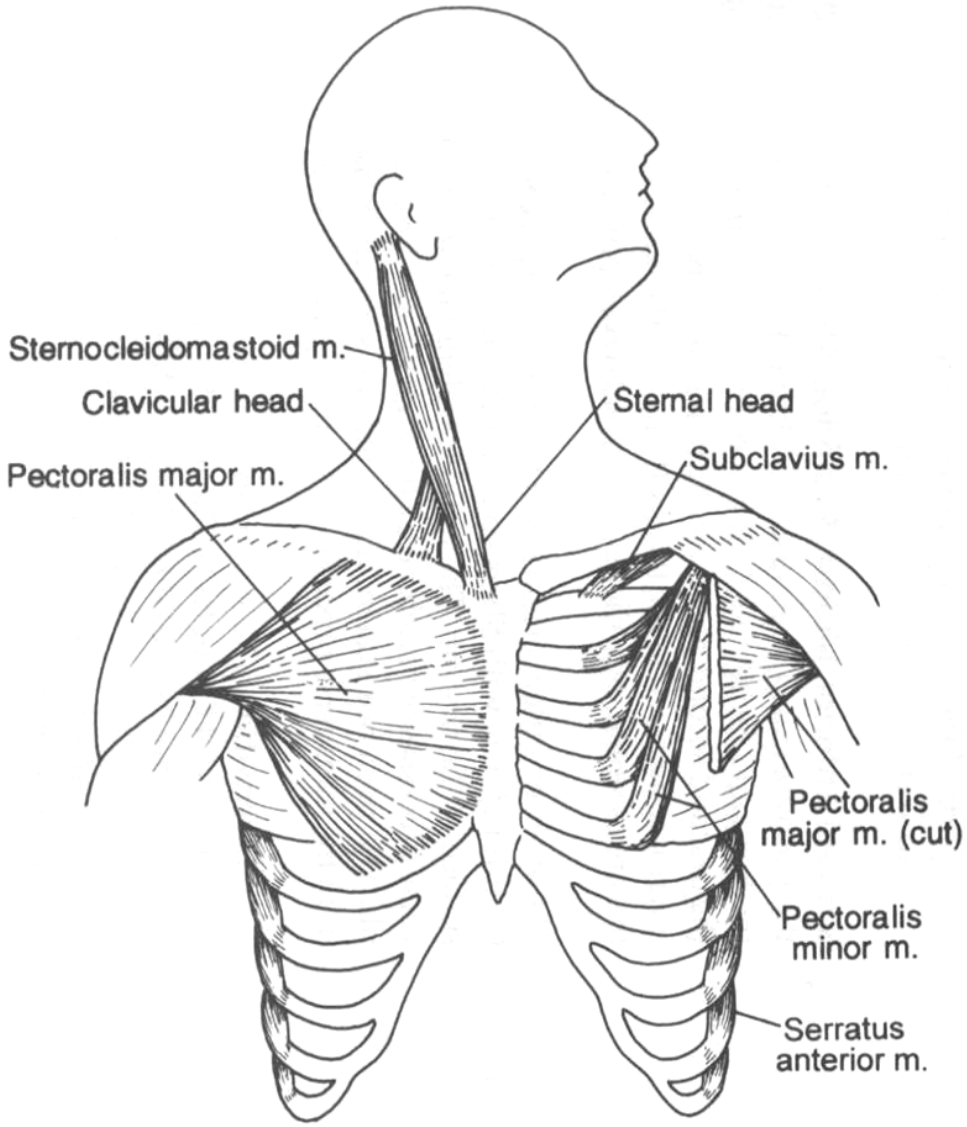

Pericardial sac fused with central tendon
Bare area of pericardium
Sternal reflection of left pleura
Costomediastinal recess
Fat pad
Left phrenic nerve
Sternal reflection of right pleura
Internal thoracic vessels
Transverse thoracic muscle
Diaphragmatic part*
External oblique
Right phrenic nerve
Inferior vena cava
Central tendon of diaphragm
Central tendon
Diaphragmatic part*
Costodiaphragmatic recess
Costal part*
Latissimus dorsi m.
Serratus posterior inferior m.
Sympathetic trunk
Esophagus
Aorta
Thoracic duct
Azygos vein
Splanchnic nerve
Superior view
* of parietal pleura

Neck Inspiratory Muscles

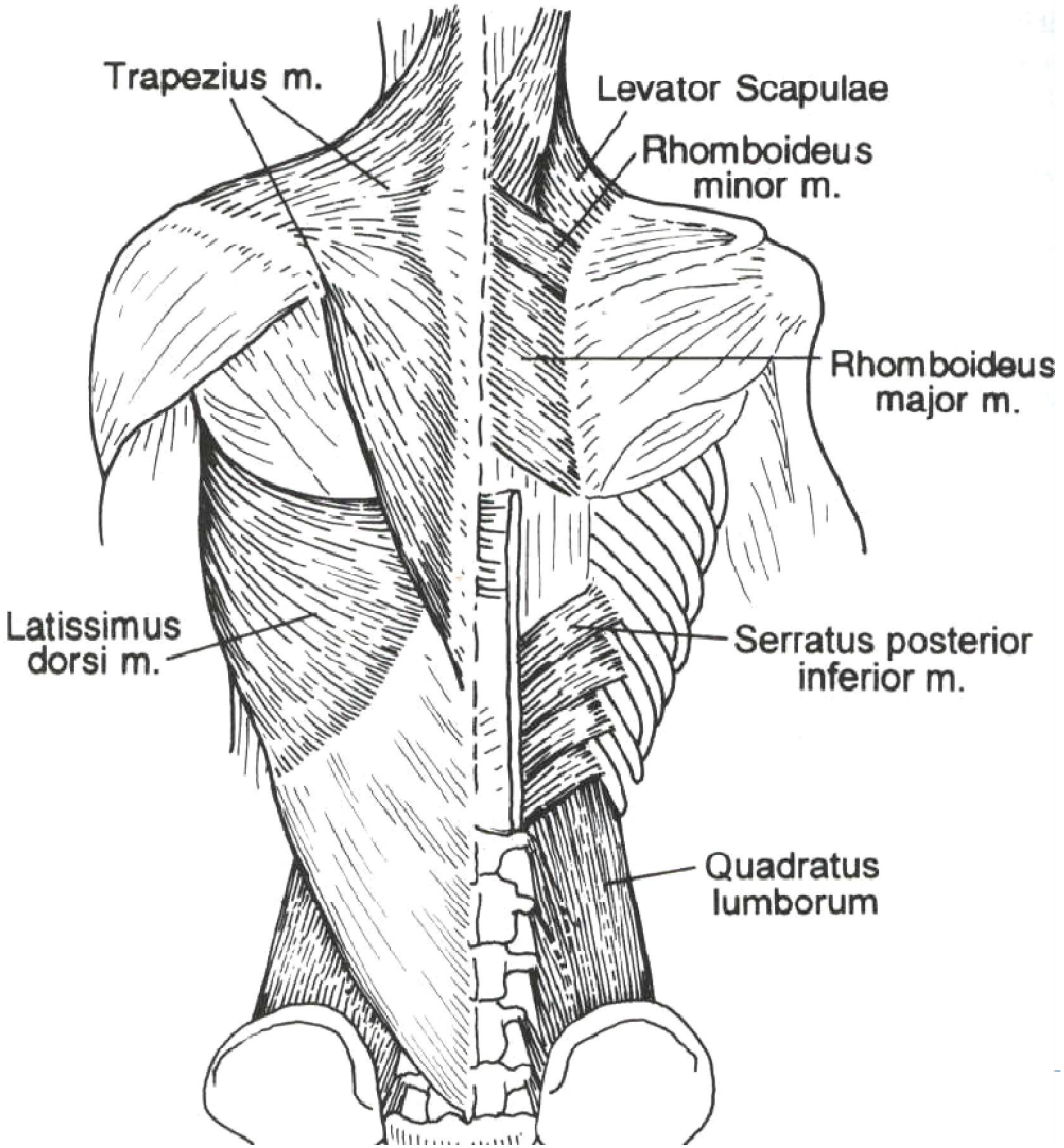


ANTERIOR VIEW

Anterior Inspiratory Muscles



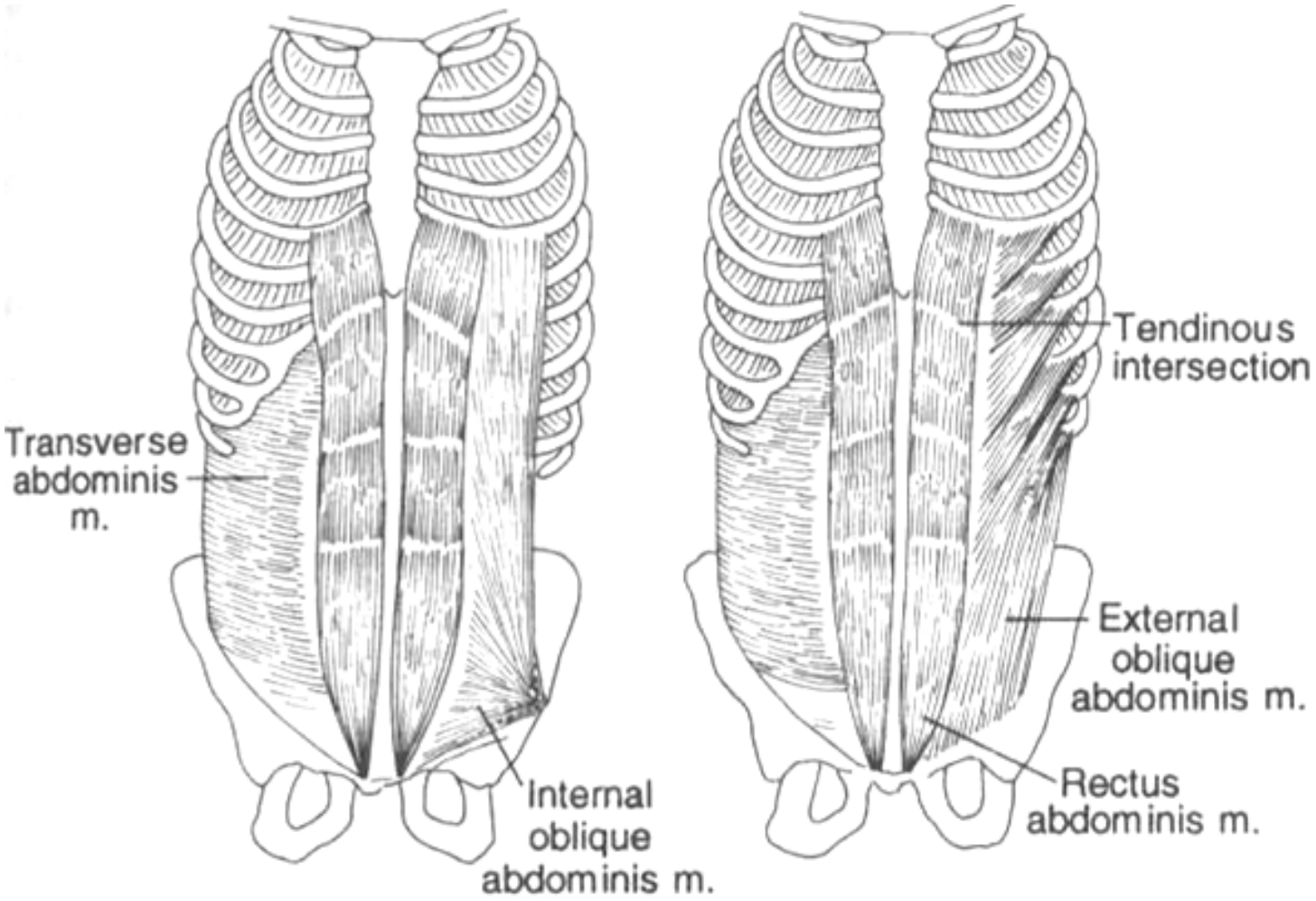
Posterior Inspiratory Muscles



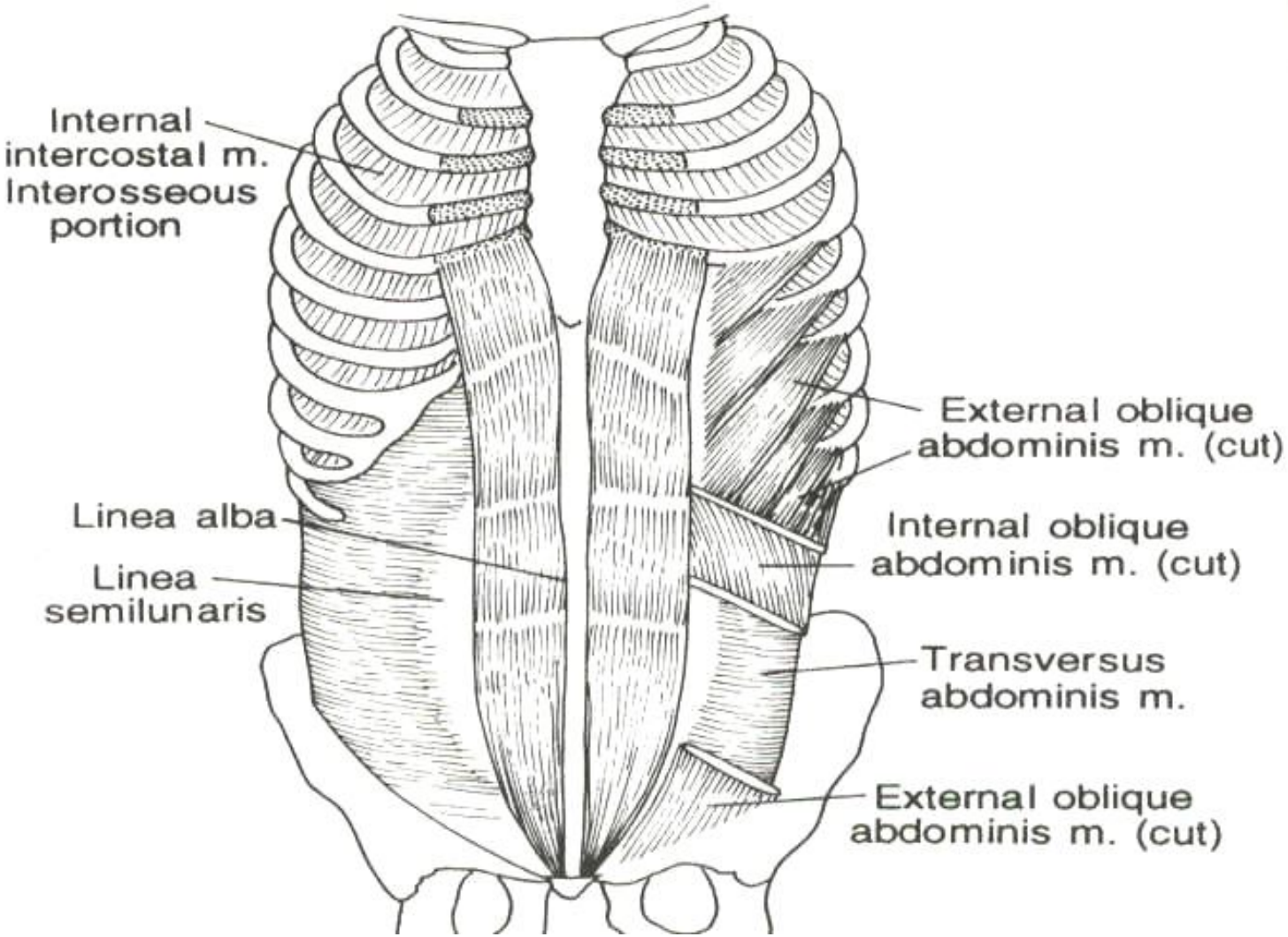
muscles that can be involved in inhalation include:

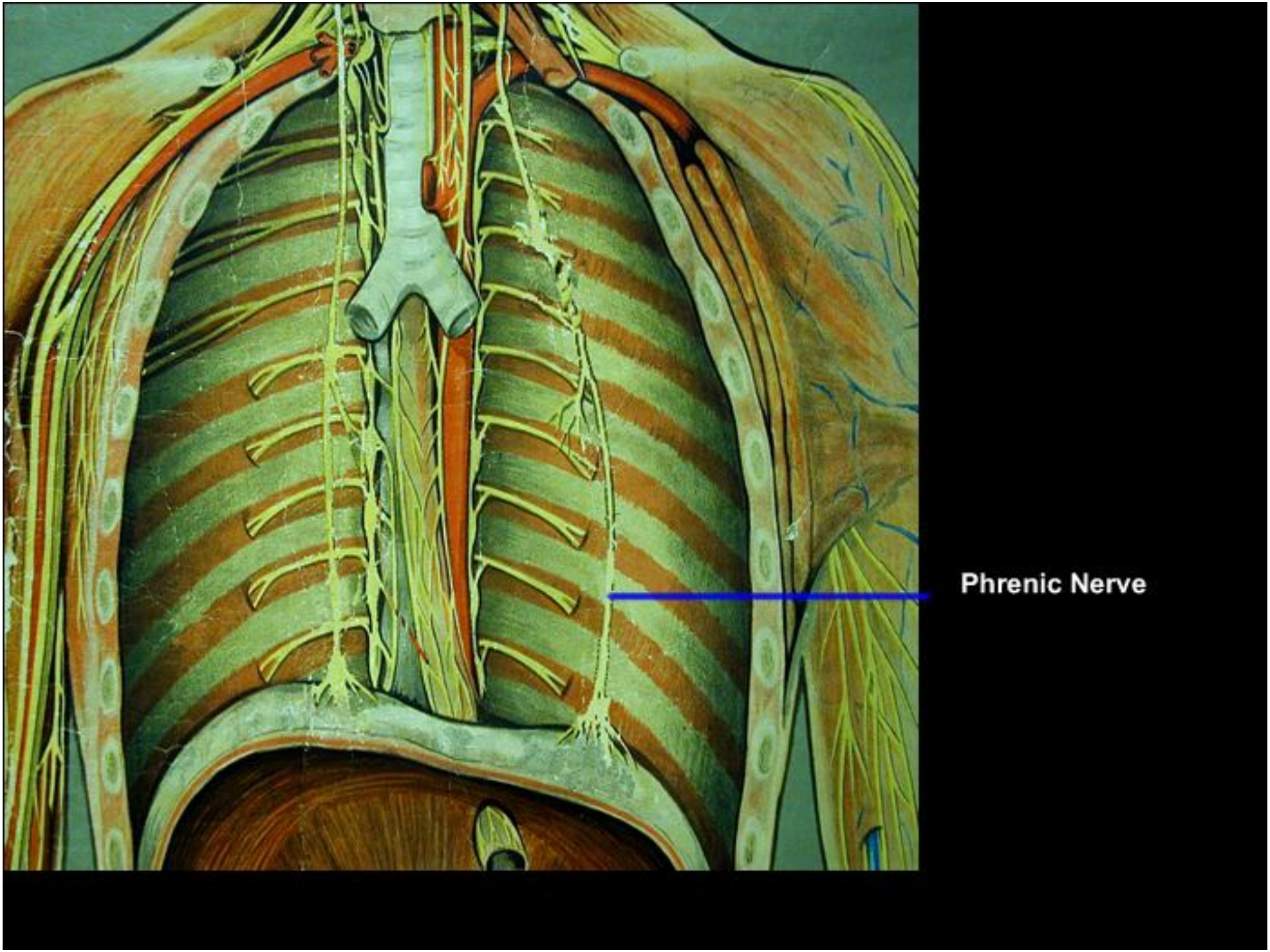
- External intercostal muscles
- Scalene muscles
- Sternocleidomastoid muscle
- Trapezius muscle

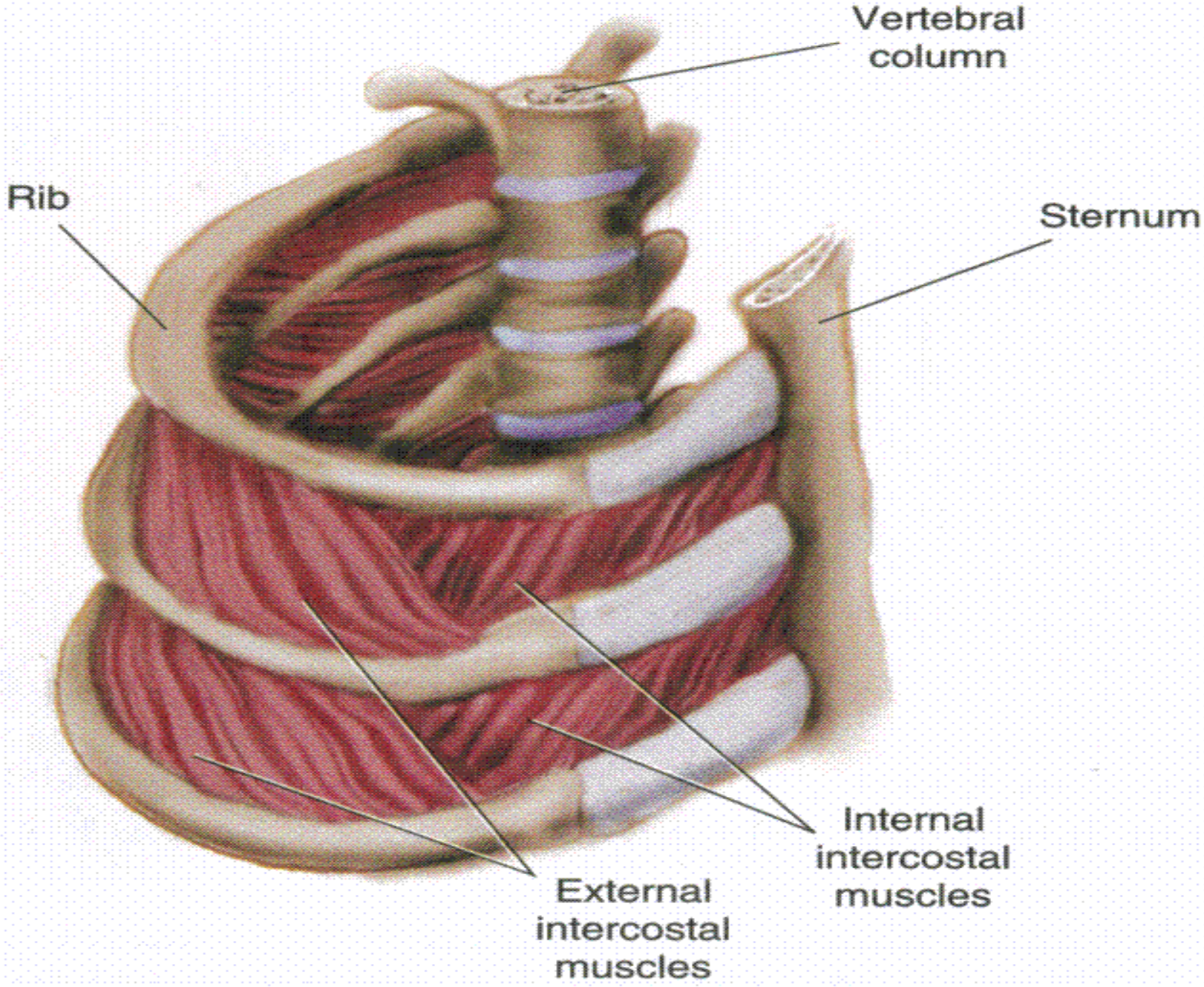
Anterior Expiratory Muscles



Anterior Expiratory Muscles

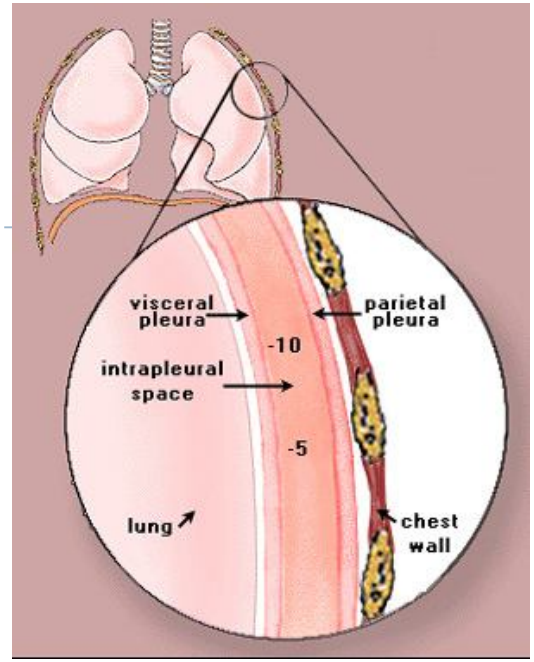


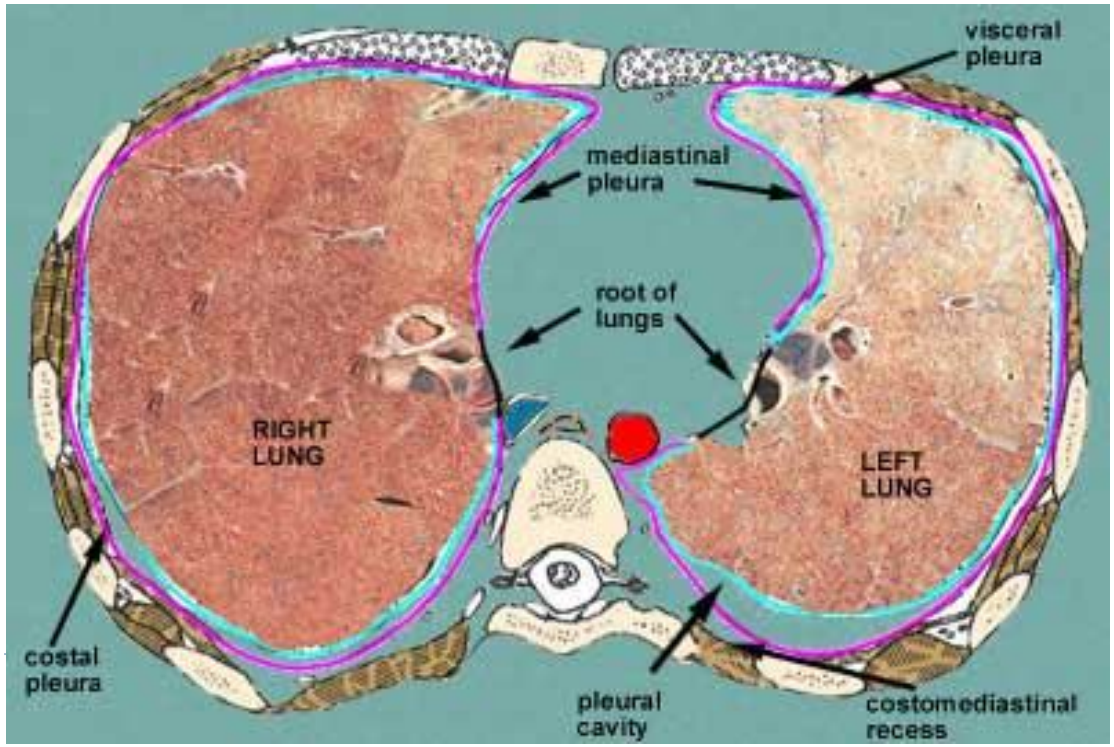

Phrenic Nerve


Vertebral column
Rib
Sternum
Internal intercostal muscles
External intercostal muscles

Pleural Linings

- Thoracic linings – parietal pleurae
- Mediastinal pleura
- Pericardial
- Diaphragmatic
- Costal
- Apical
- Visceral





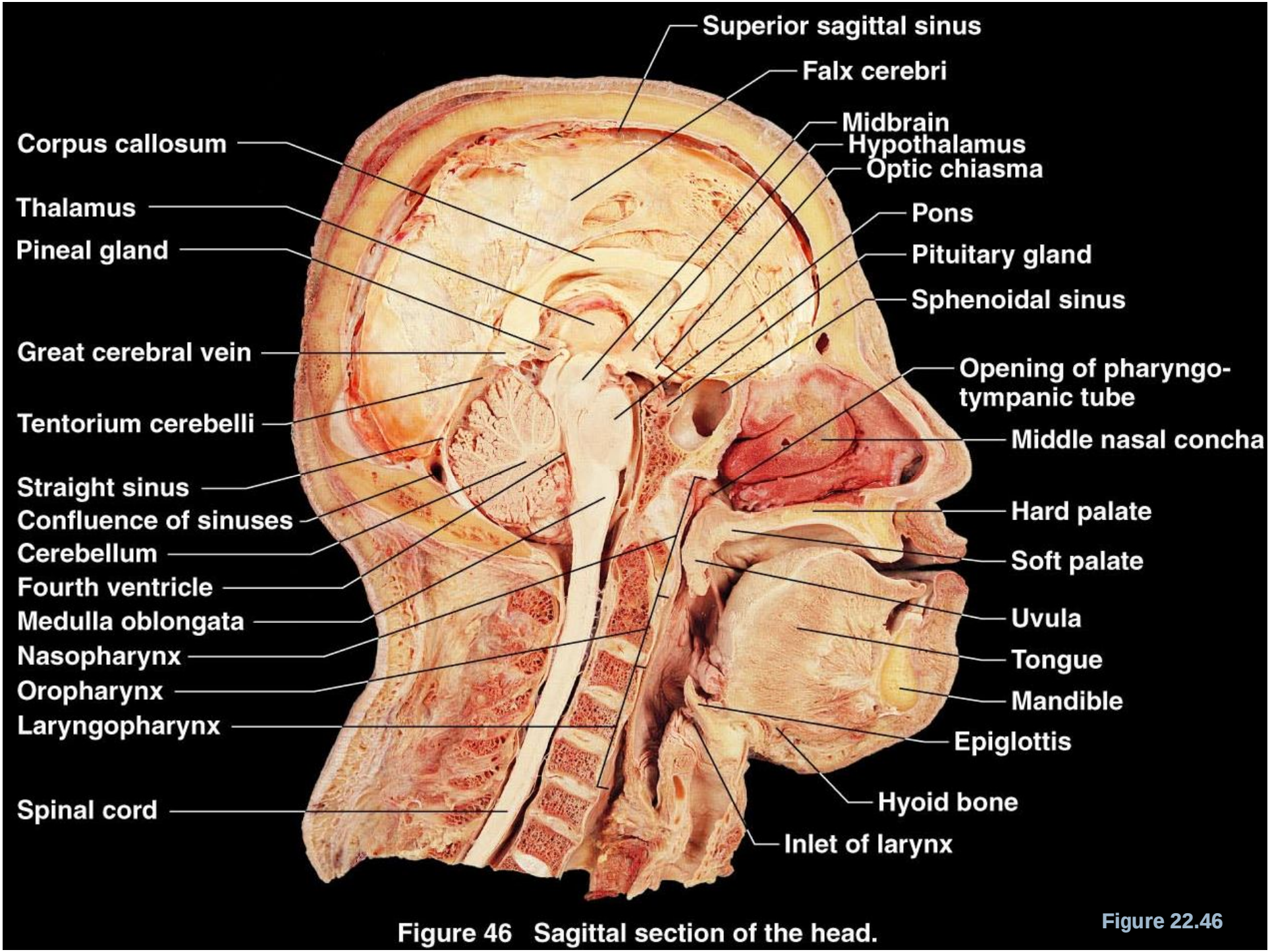


Figure 46 Sagittal section of the head.

Figure 22.46

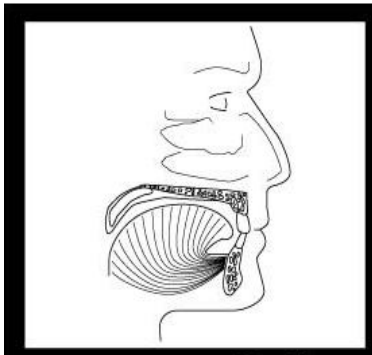
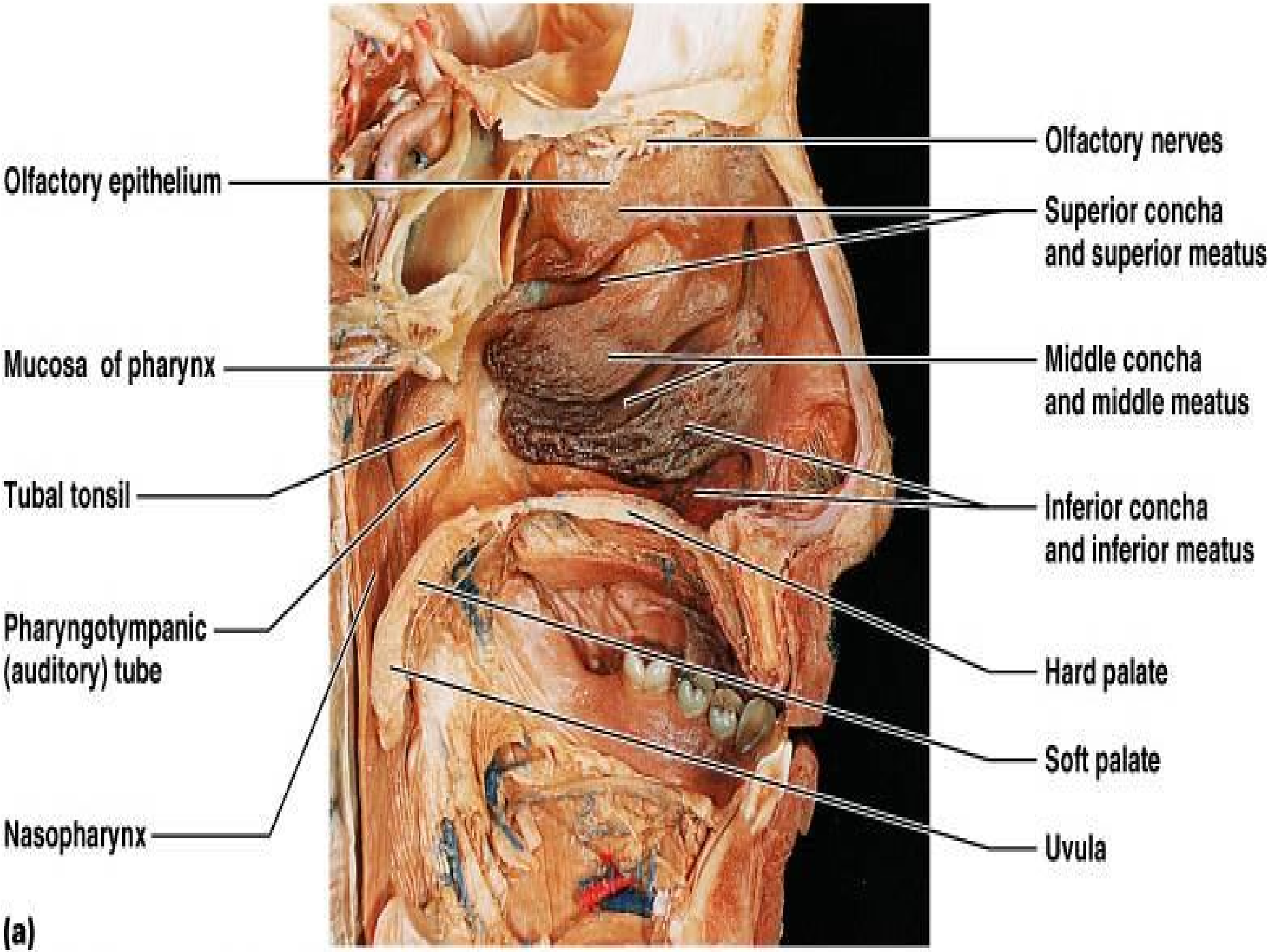
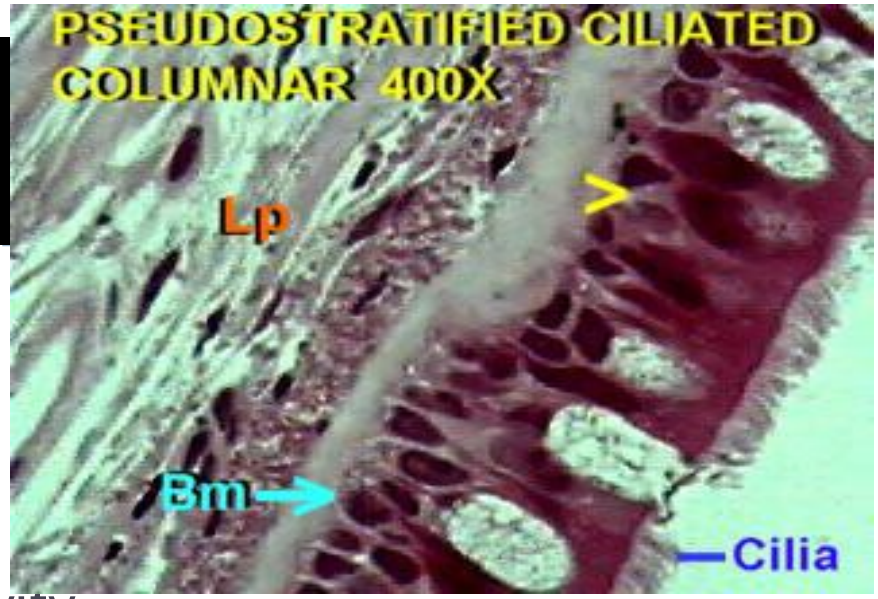


Figure 47 Left nasal cavity, lateral wall.

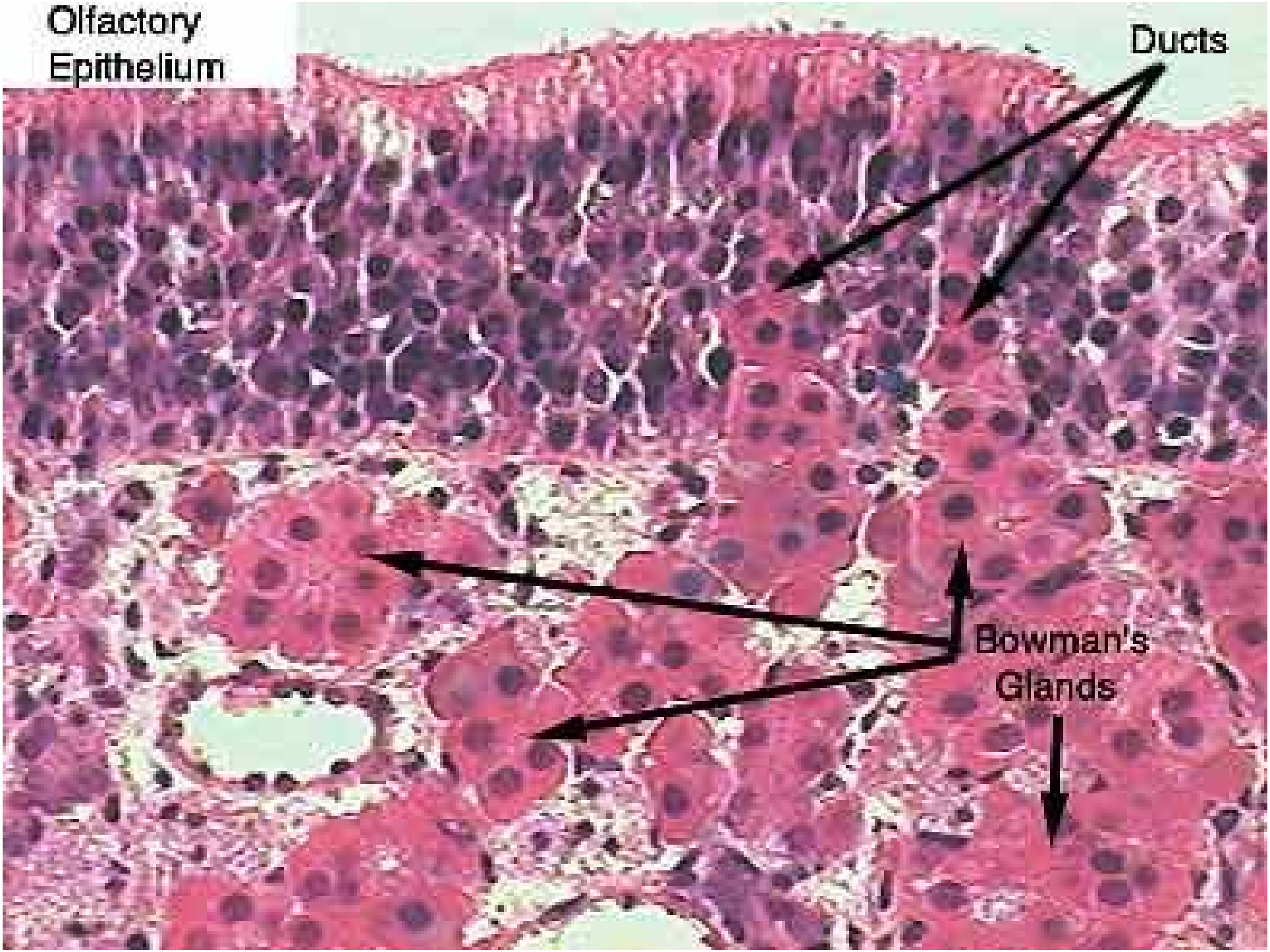
Figure 22.47

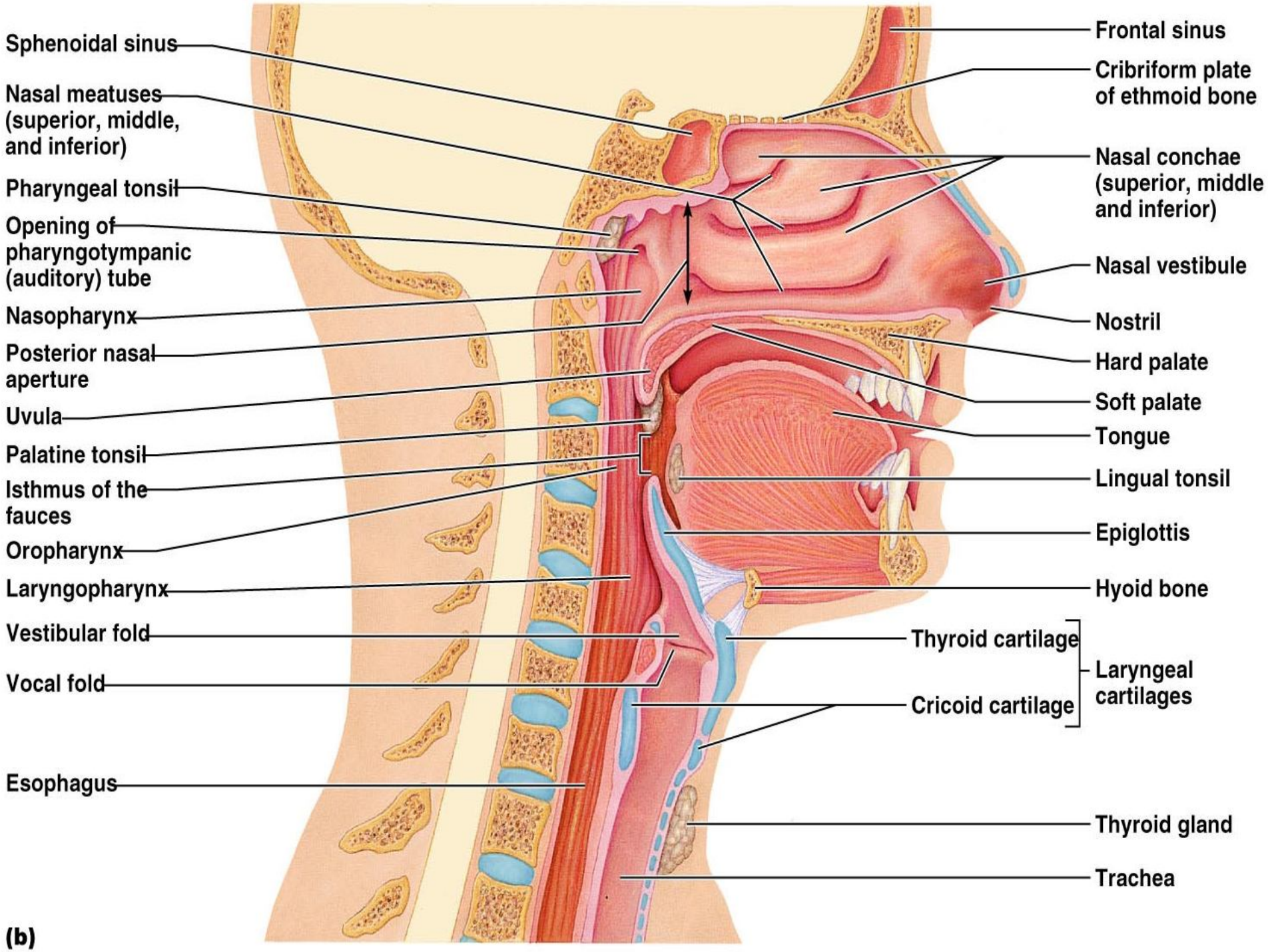

Olfactory epithelium
Mucosa of pharynx
Tubal tonsil
Pharyngotympanic (auditory) tube
Nasopharynx
Olfactory nerves
Superior concha and superior meatus
Middle concha and middle meatus
Inferior concha and inferior meatus
Hard palate
Soft palate
Uvula
(a)

Nasal Cavity



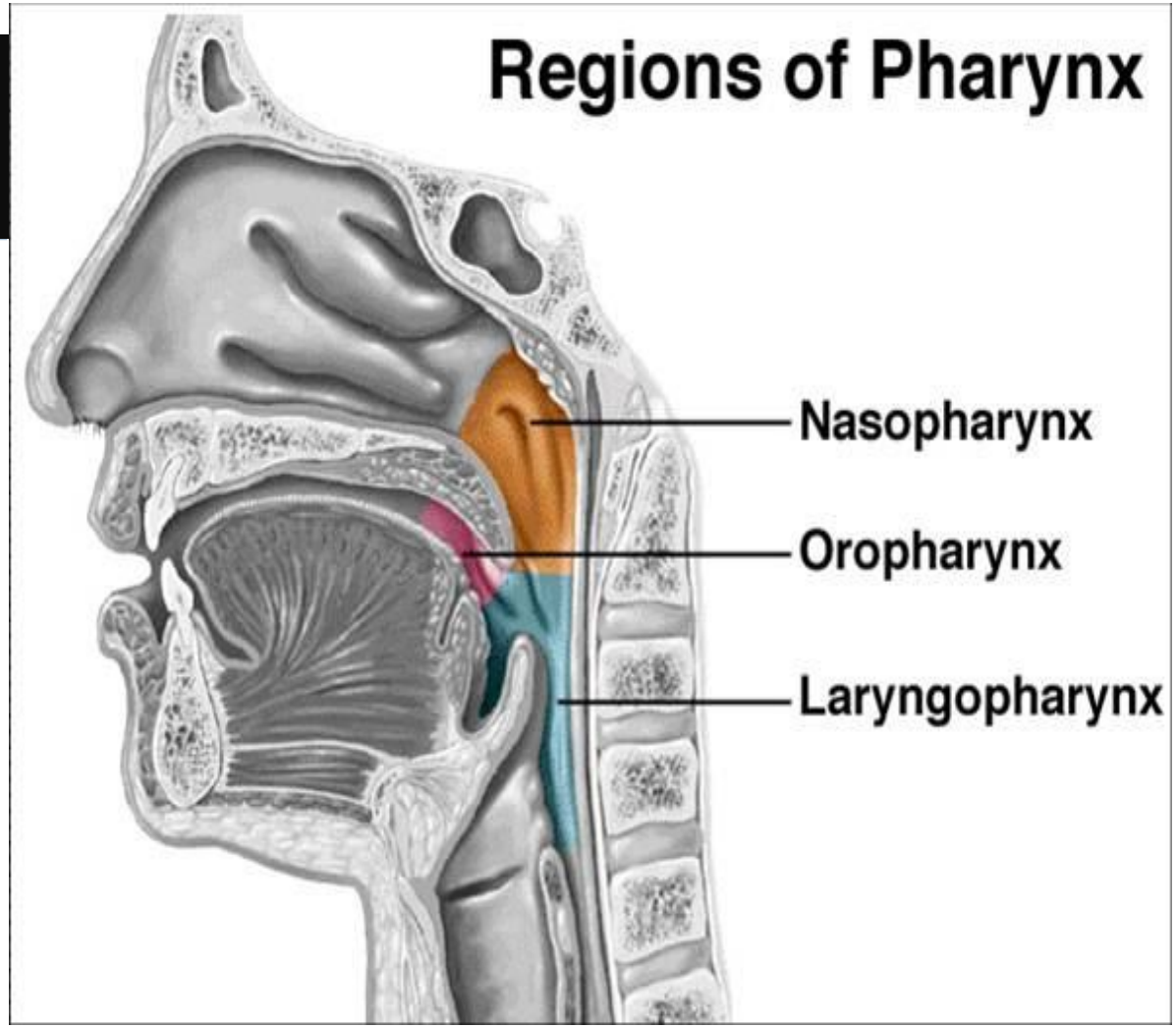
- **Respiratory mucosa**
  - Lines the balance of the nasal cavity
  - Glands secrete mucus containing **lysozyme and defensins to help destroy bacteria**

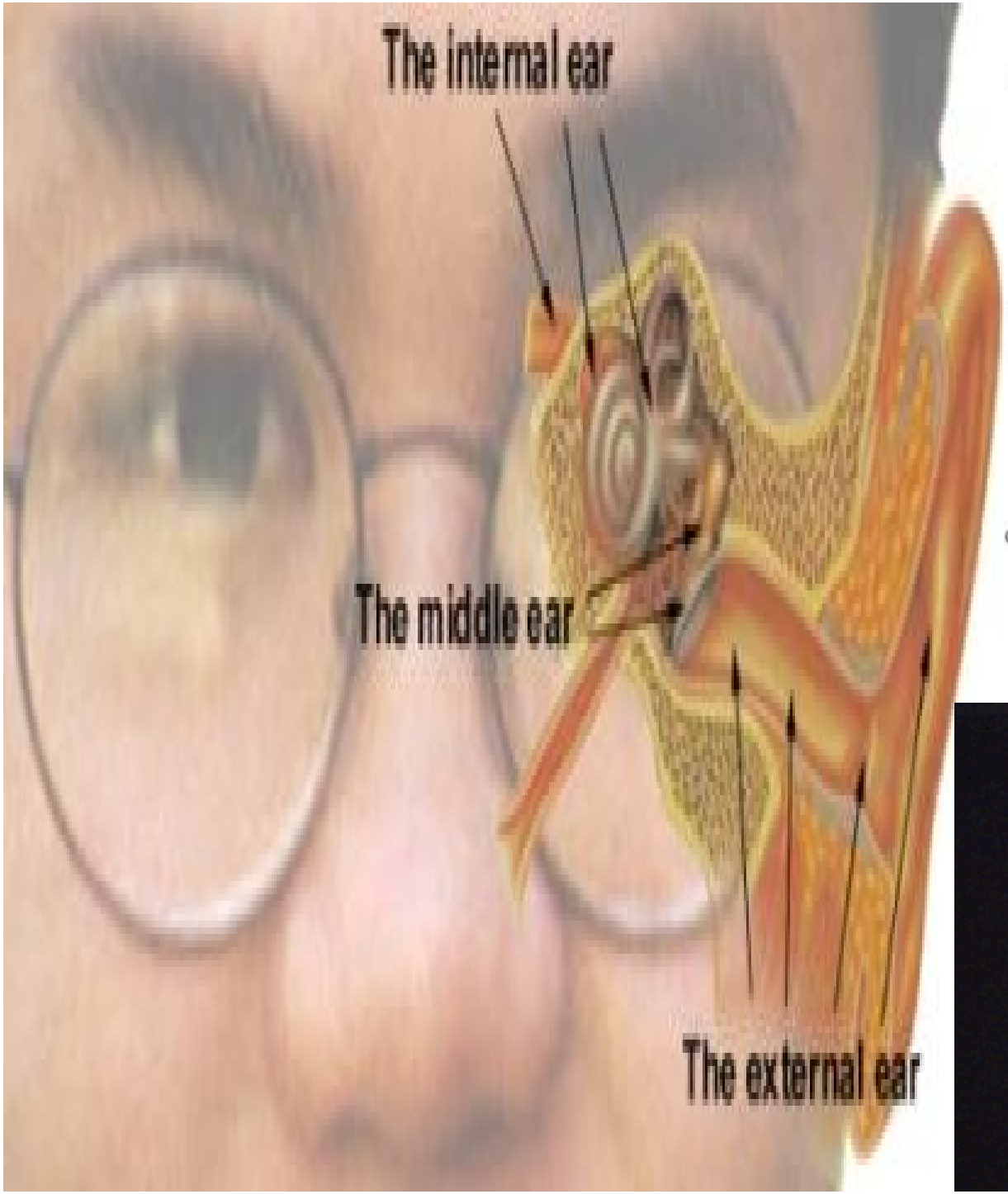

Olfactory
Epithelium
Ducts
Bowman's
Glands

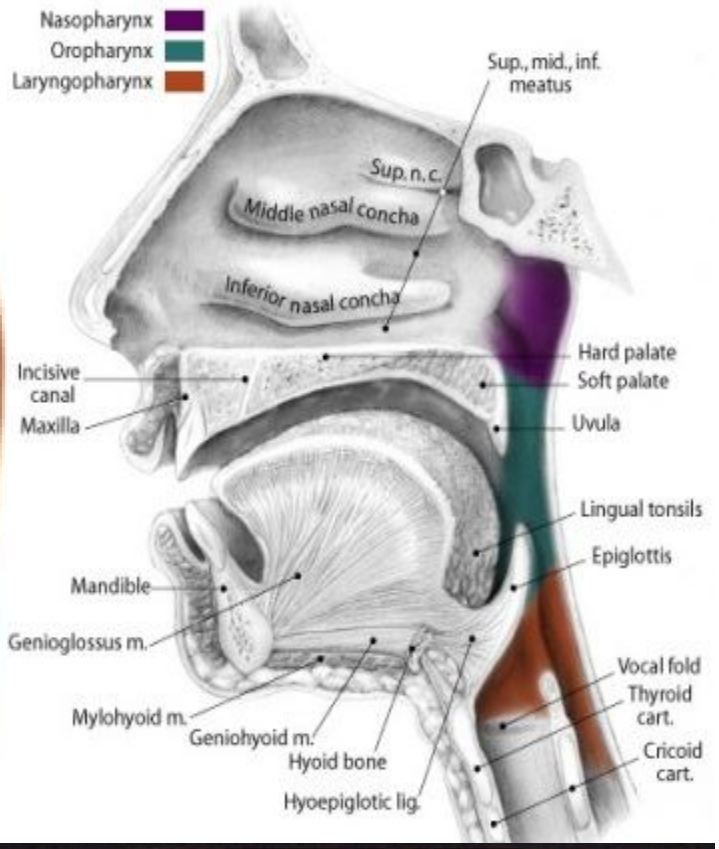

Sphenoidal sinus
Nasal meatuses (superior, middle, and inferior)
Pharyngeal tonsil
Opening of pharyngotympanic (auditory) tube
Nasopharynx
Posterior nasal aperture
Uvula
Palatine tonsil
Isthmus of the fauces
Oropharynx
Laryngopharynx
Vestibular fold
Vocal fold
Esophagus
Frontal sinus
Cribriform plate of ethmoid bone
Nasal conchae (superior, middle and inferior)
Nasal vestibule
Nostril
Hard palate
Soft palate
Tongue
Lingual tonsil
Epiglottis
Hyoid bone
Thyroid cartilage
Cricoid cartilage
Laryngeal cartilages
Thyroid gland
Trachea
(b)

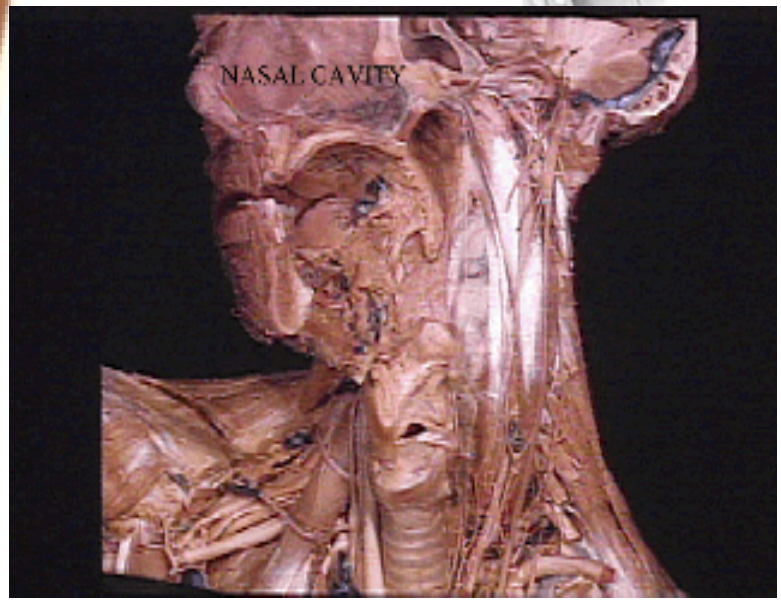
Pharynx

- It is divided into three regions
  - **Nasopharynx**
  - **Oropharynx**
  - **Laryngopharynx**




The internal ear
The middle ear
The external ear


Nasopharynx
Oropharynx
Laryngopharynx
Sup., mid., inf. meatus
Sup. n. c.
Middle nasal concha
Inferior nasal concha
Hard palate
Soft palate
Incisive canal
Maxilla
Uvula
Lingual tonsils
Epiglottis
Mandible
Genioglossus m.
Vocal fold
Thyroid cart.
Mylohyoid m.
Geniohyoid m.
Hyoid bone
Cricoid cart.
Hyoepiglotic lig.


NASAL CAVITY

Larynx

- Routes food and air down their correct passages.
- Contains the **vocal cords**, which function in voice production.
- Arrangement of **9 cartilages connected by membranes** and ligaments and lined by respiratory epithelium.
- **Cartilages include thyroid, cricoid, epiglottis and 3 small paired cartilages**.
- **All cartilages are hyaline with the exception of the epiglottis, which is elastic cartilage.**
- **Thyroid cartilage is the largest and its midline laryngeal prominence is the male "Adam's apple."**
- Inferior to the thyroid is the signet-ring shaped cricoid cartilage.
- The 3 pairs of small cartilages form much of the posterior and lateral larynx.

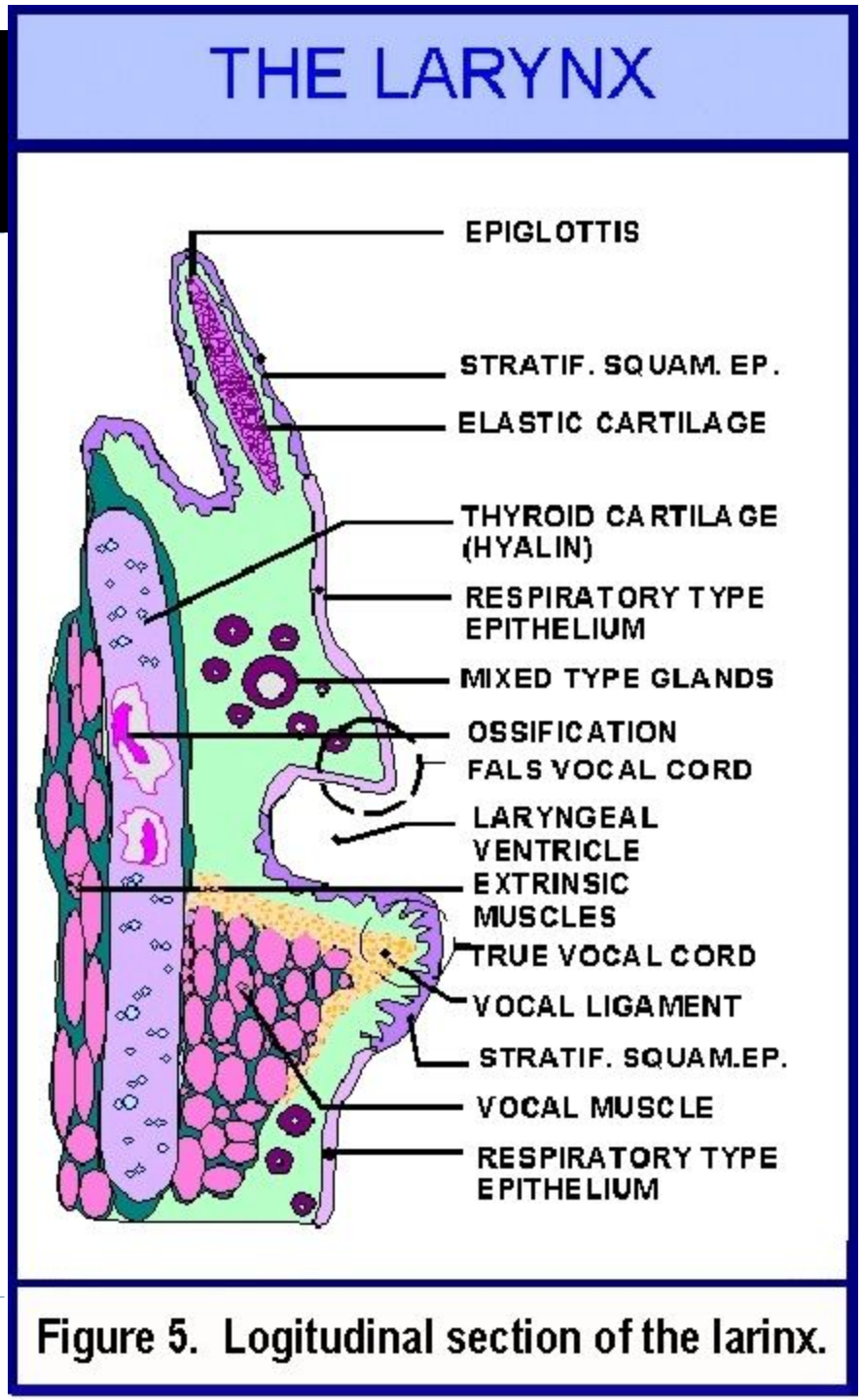
- The **epiglottis** extends from the base of the tongue to its hinge on the superior thyroid cartilage. During swallowing, the epiglottis tips and covers the entrance to the larynx and ensures that food enters the esophagus.

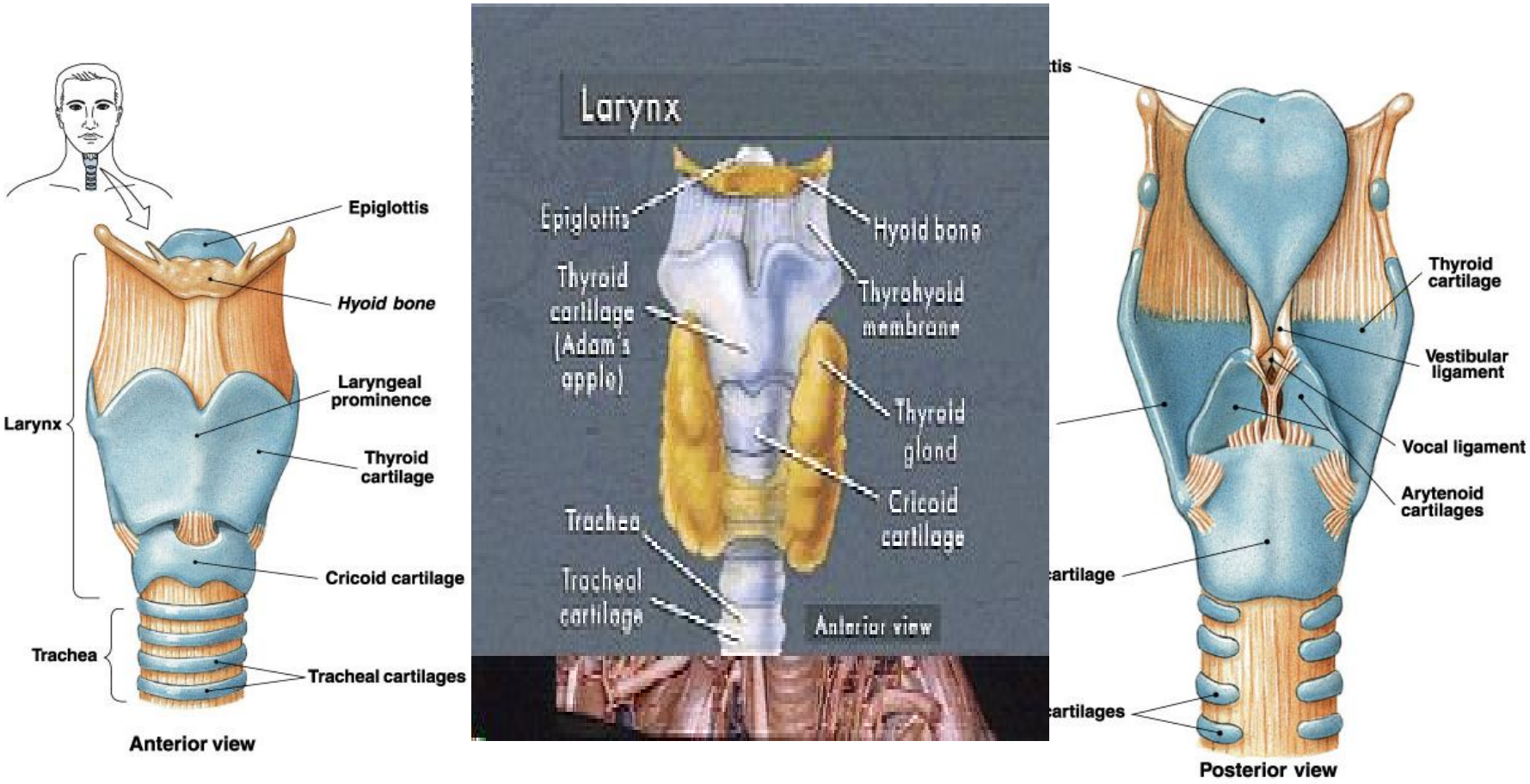
The Larynx.....

Major cartilage are:

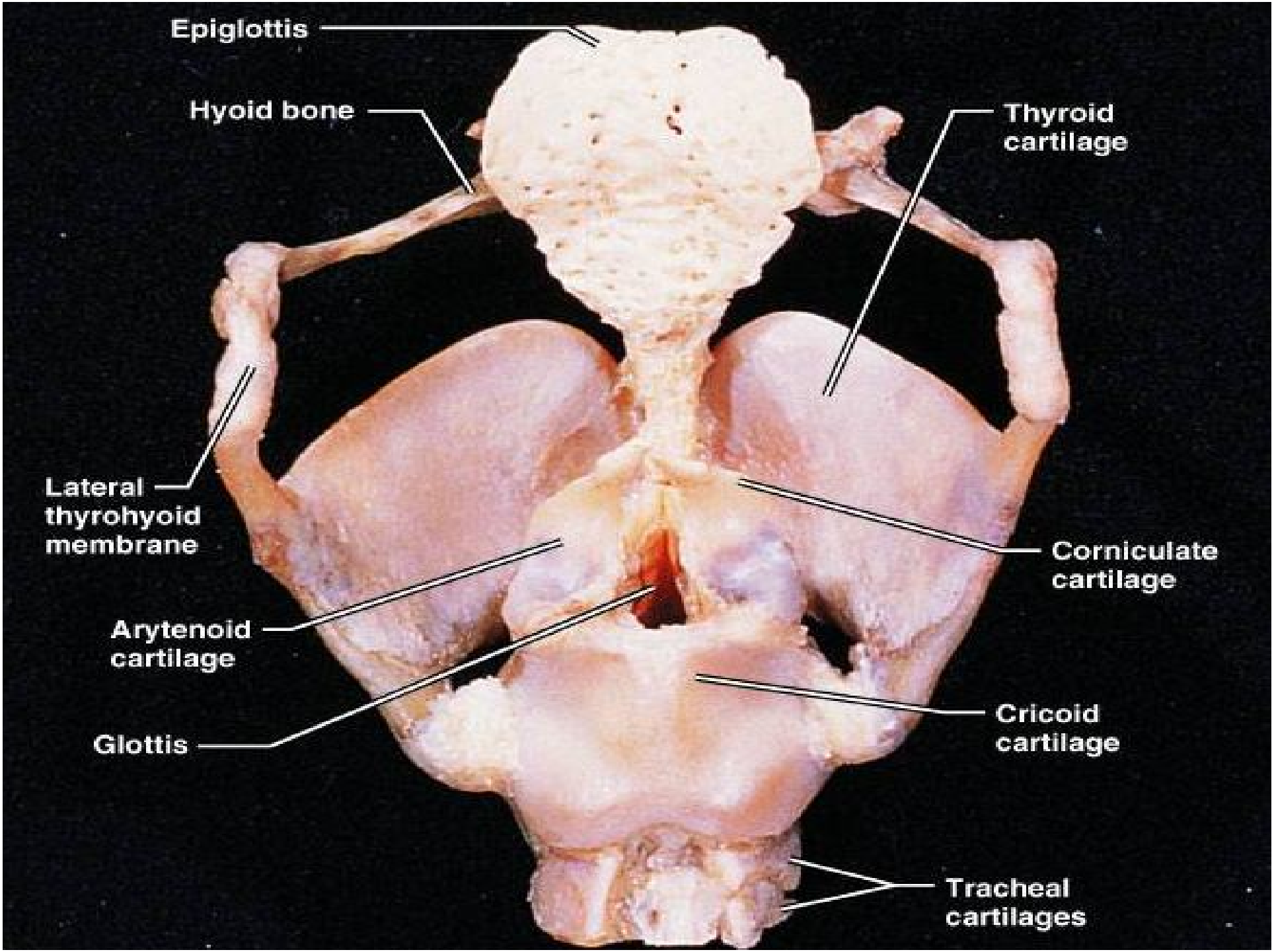
Hyaline type.

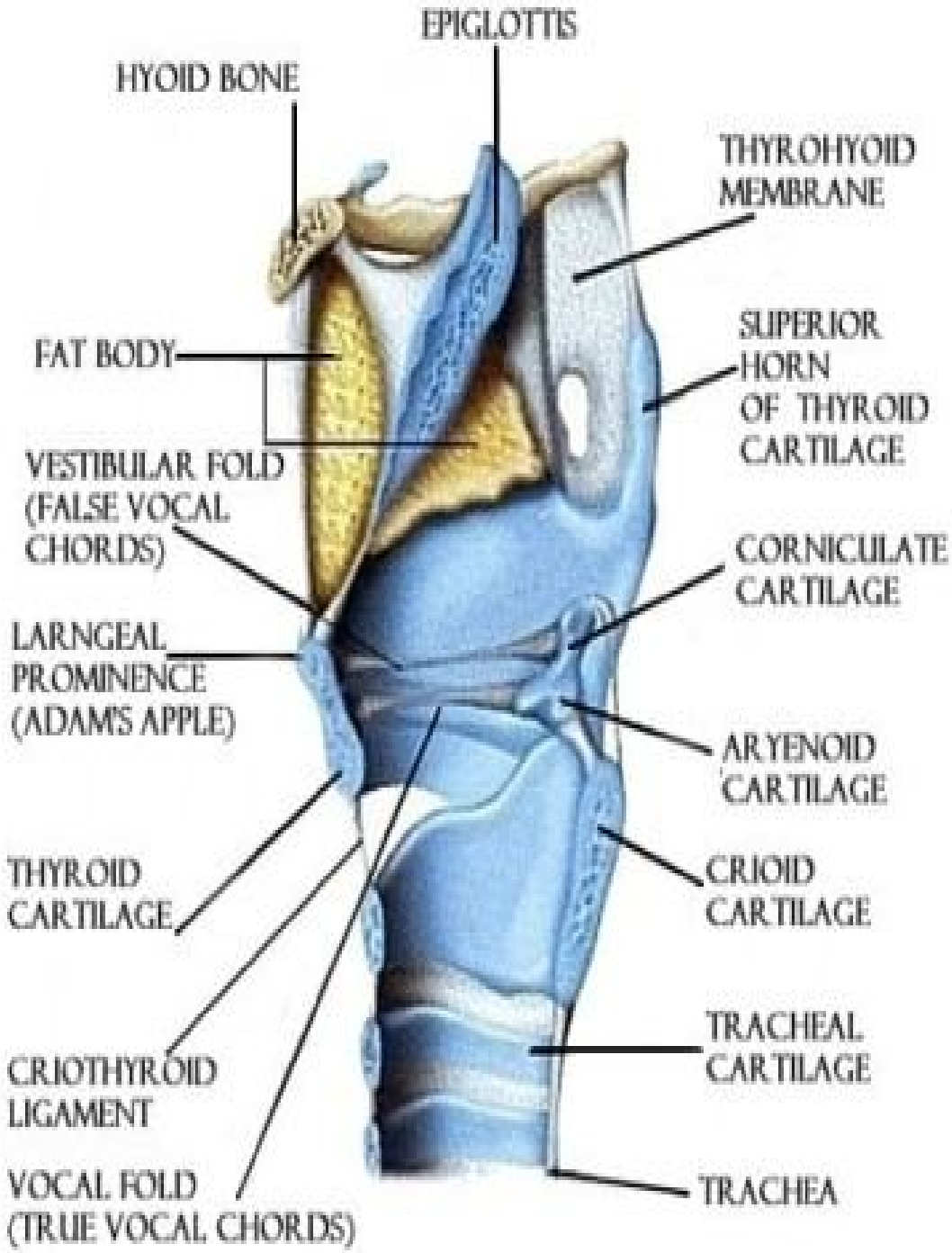
- thyroid
- cricoid
- arytenoids

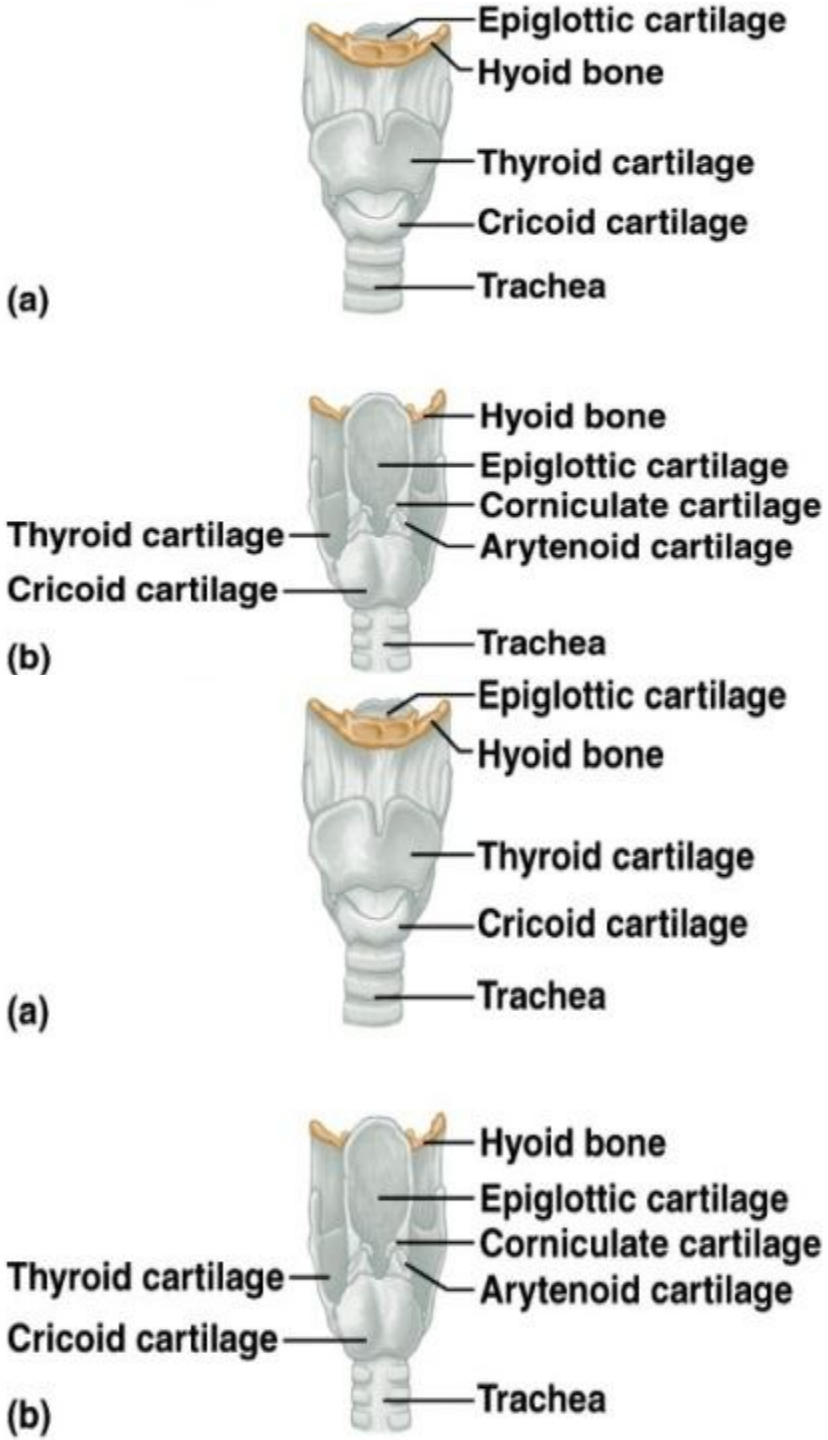


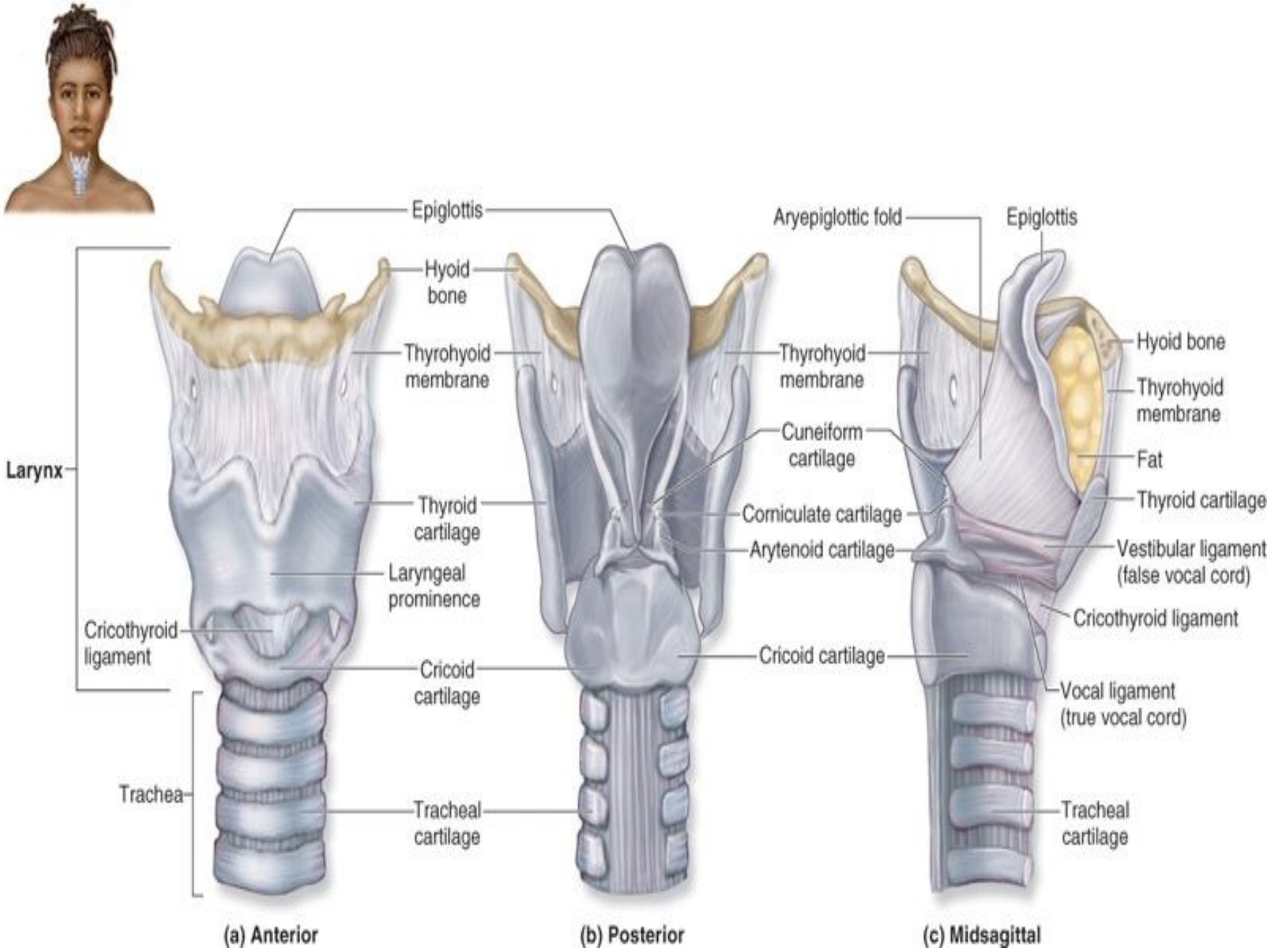


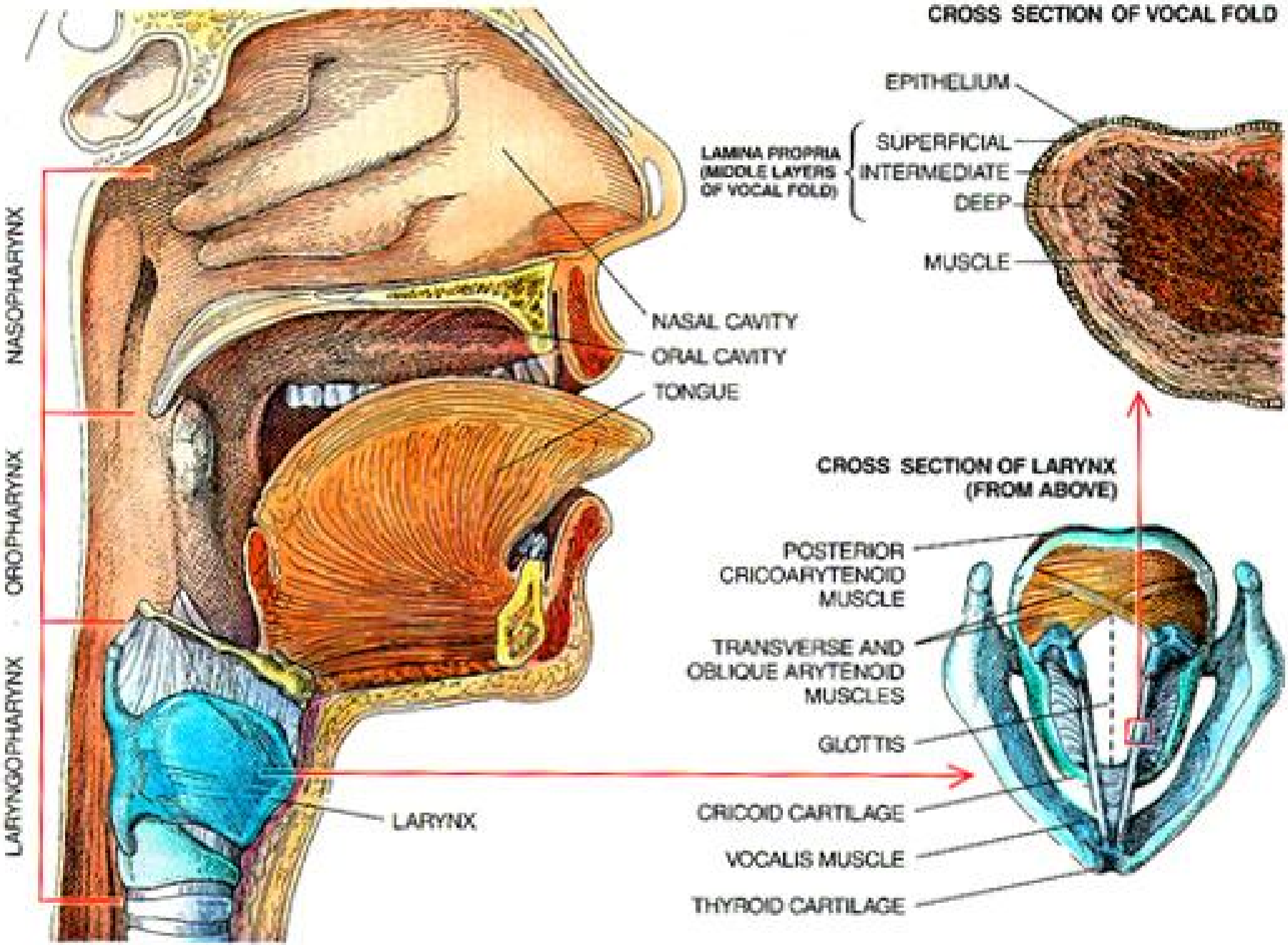
- Functions
  - Maintain an open passageway for air movement
  - Epiglottis and vestibular folds prevent swallowed material from moving into larynx
  - Vocal folds are primary source of sound production


Epiglottis
Hyoid bone
Thyroid cartilage
Lateral thyrohyoid membrane
Corniculate cartilage
Arytenoid cartilage
Glottis
Cricoid cartilage
Tracheal cartilages


EPIGLOTTIS
HYOID BONE
THYROHYOID MEMBRANE
FAT BODY
SUPERIOR HORN OF THYROID CARTILAGE
VESTIBULAR FOLD (FALSE VOCAL CHORDS)
CORNICULATE CARTILAGE
LARNGEAL PROMINENCE (ADAM'S APPLE)
ARYENOID CARTILAGE
THYROID CARTILAGE
CRIOID CARTILAGE
TRACHEAL CARTILAGE
CRIOTHYROID LIGAMENT
VOCAL FOLD (TRUE VOCAL CHORDS)
TRACHEA


Epiglottic cartilage
Hyoid bone
Thyroid cartilage
Cricoid cartilage
Trachea
(a)
Hyoid bone
Epiglottic cartilage
Corniculate cartilage
Arytenoid cartilage
Thyroid cartilage
Cricoid cartilage
Trachea
(b)
Epiglottic cartilage
Hyoid bone
Thyroid cartilage
Cricoid cartilage
Trachea
(a)
Hyoid bone
Epiglottic cartilage
Corniculate cartilage
Arytenoid cartilage
Thyroid cartilage
Cricoid cartilage
Trachea
(b)


Epiglottis
Hyoid bone
Thyrohyoid membrane
Larynx
Thyroid cartilage
Laryngeal prominence
Cricothyroid ligament
Cricoid cartilage
Trachea
Tracheal cartilage
(a) Anterior
Thyrohyoid membrane
Cuneiform cartilage
Corniculate cartilage
Arytenoid cartilage
Cricoid cartilage
(b) Posterior
Aryepiglottic fold
Epiglottis
Hyoid bone
Thyrohyoid membrane
Fat
Thyroid cartilage
Vestibular ligament (false vocal cord)
Cricothyroid ligament
Vocal ligament (true vocal cord)
Tracheal cartilage
(c) Midsagittal


CROSS SECTION OF VOCAL FOLD
EPITHELIUM
LAMINA PROPRIA (MIDDLE LAYERS OF VOCAL FOLD)
SUPERFICIAL
INTERMEDIATE
DEEP
MUSCLE
NASOPHARYNX
OROPHARYNX
LARYNGOPHARYNX
NASAL CAVITY
ORAL CAVITY
TONGUE
LARYNX
CROSS SECTION OF LARYNX (FROM ABOVE)
POSTERIOR CRICOARYTENOID MUSCLE
TRANSVERSE AND OBLIQUE ARYTENOID MUSCLES
GLOTTIS
CRICOID CARTILAGE
VOCALIS MUSCLE
THYROID CARTILAGE

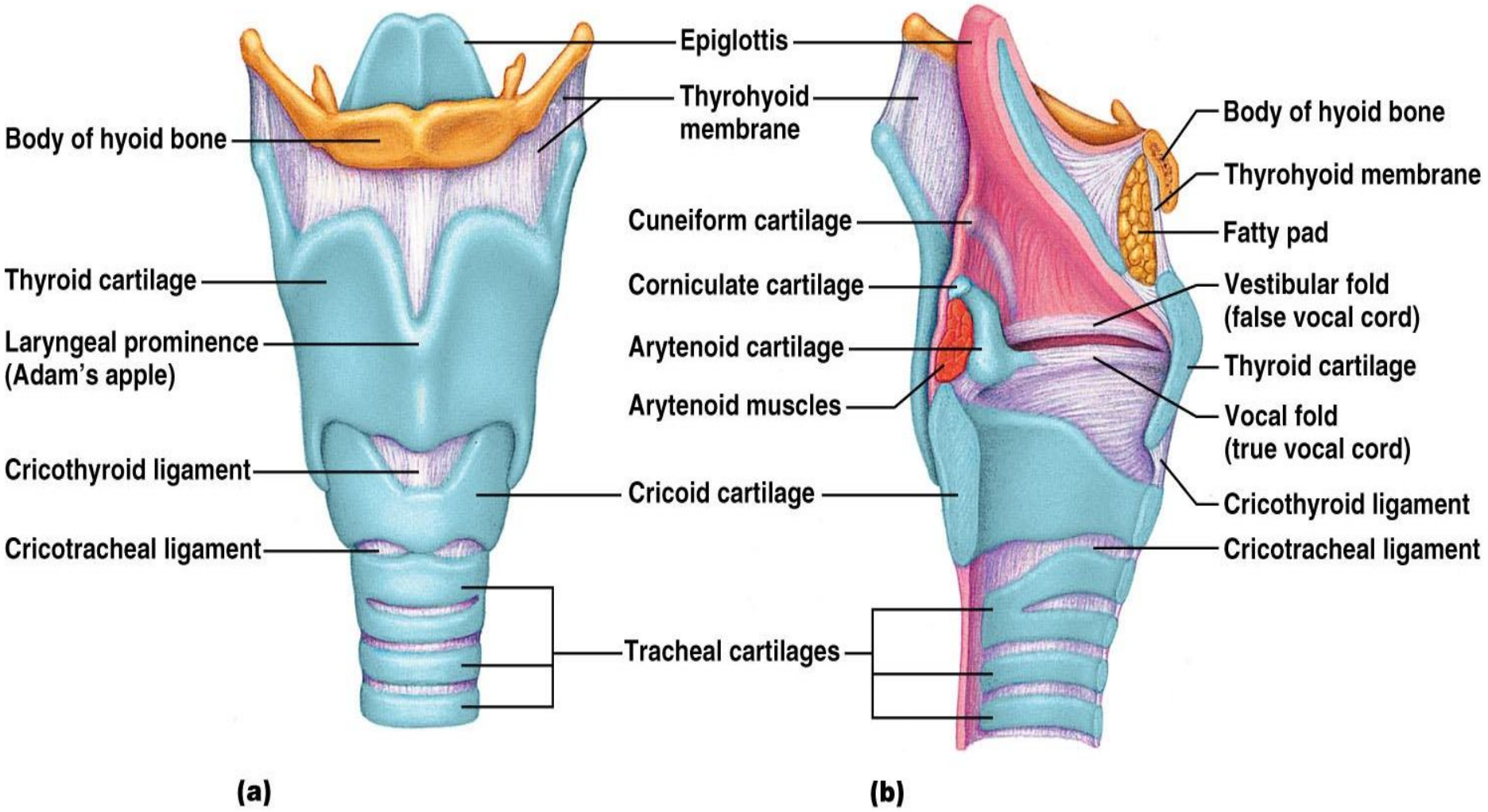
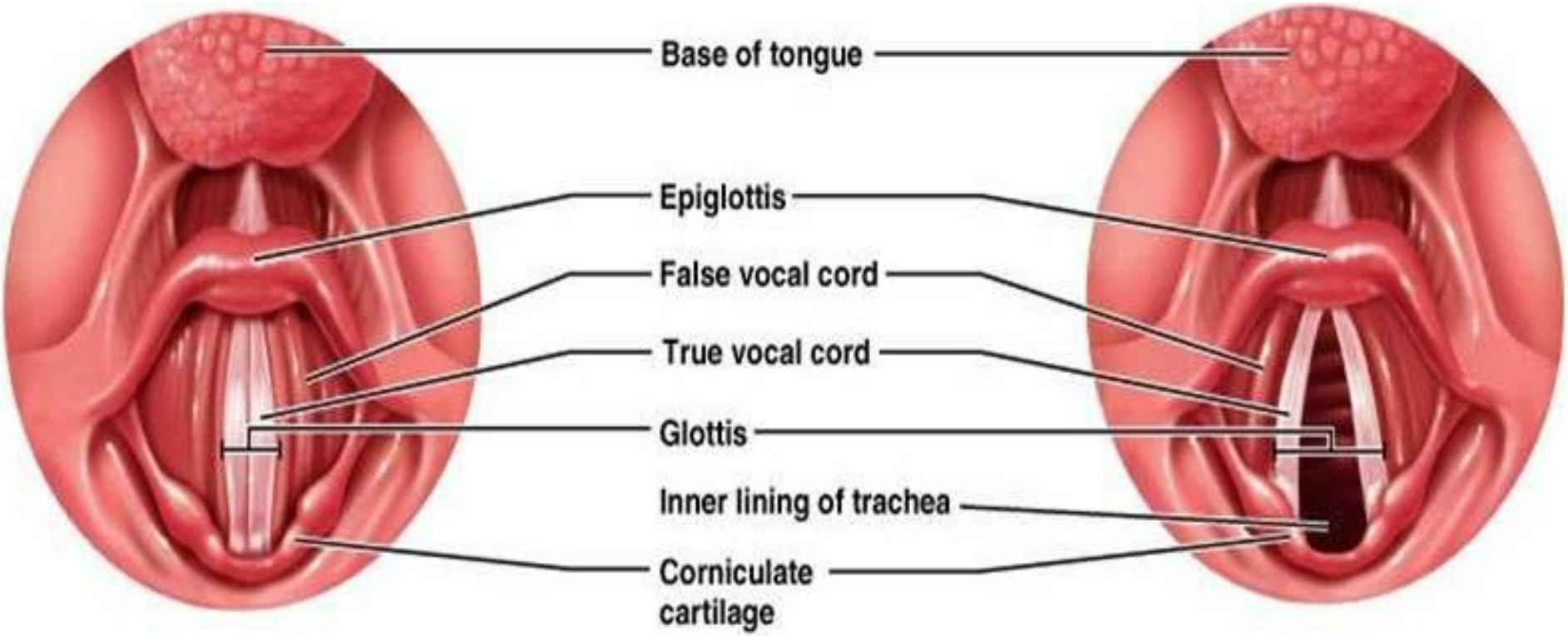
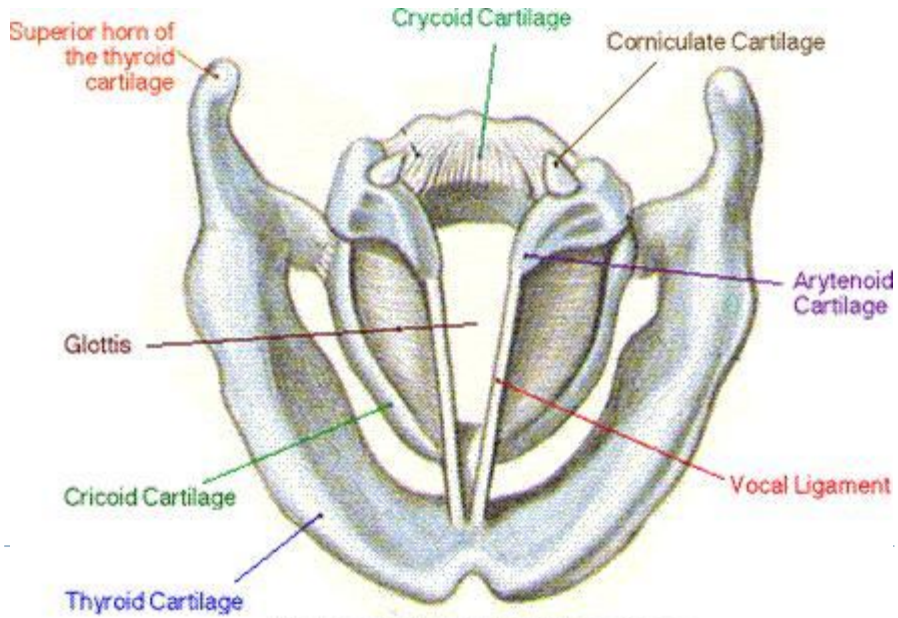


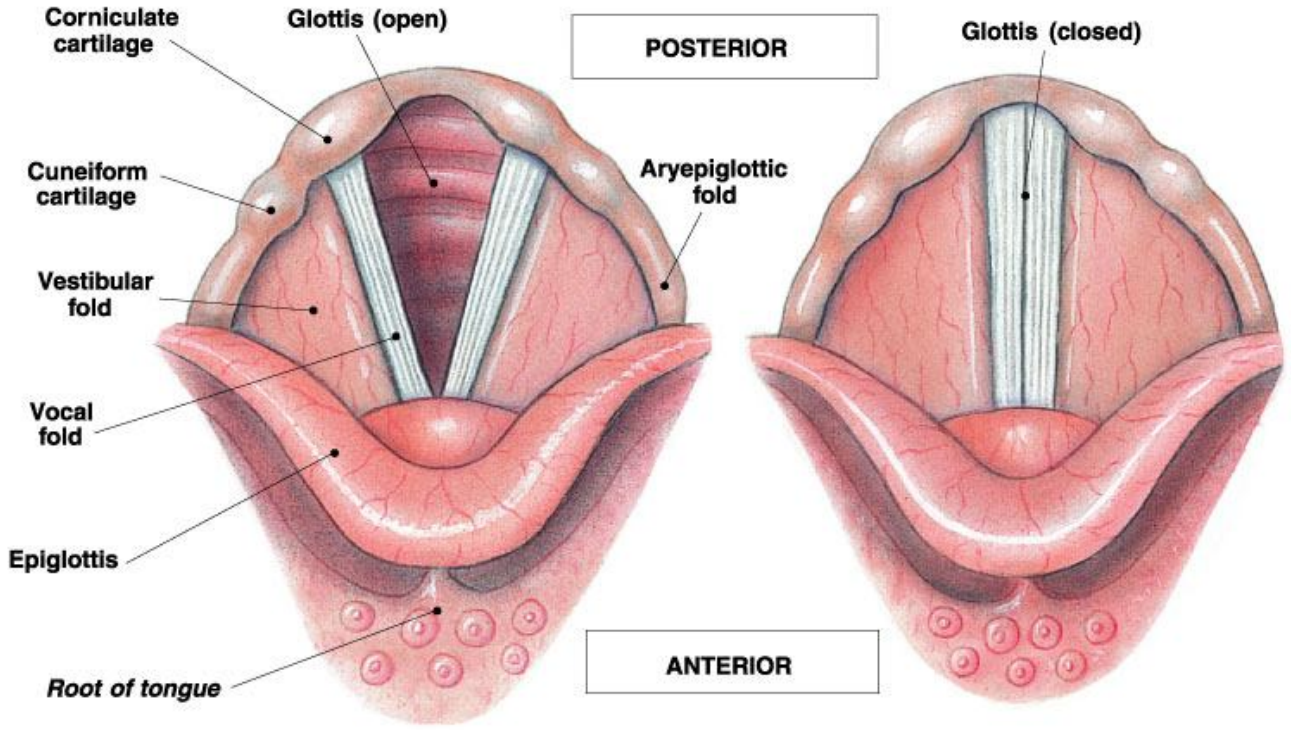
Figure 22.4a, b



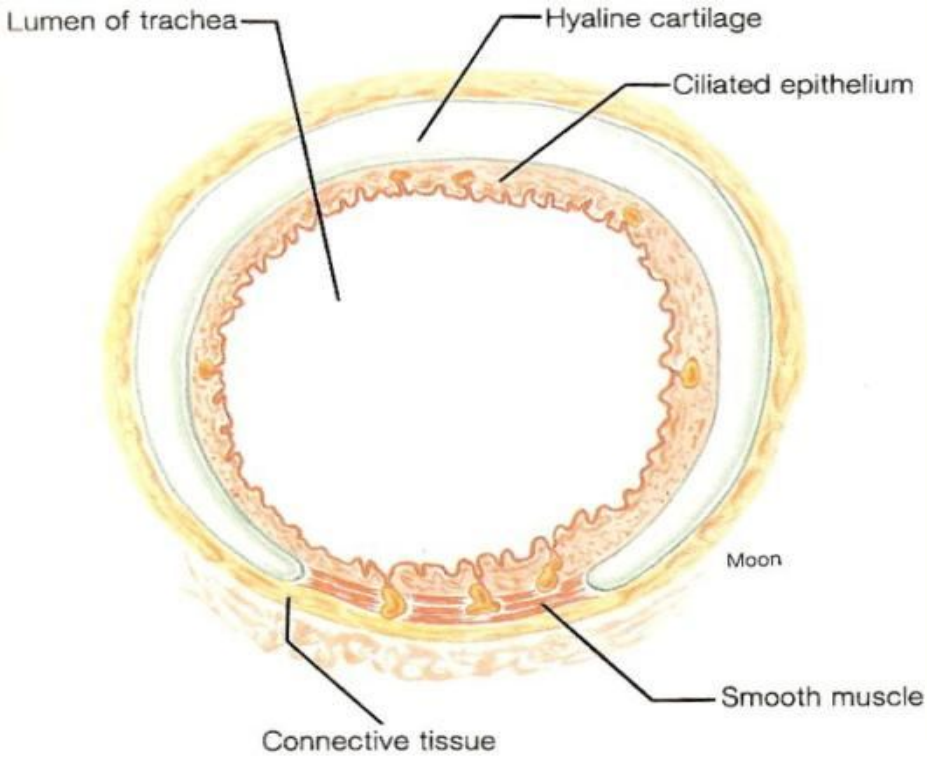


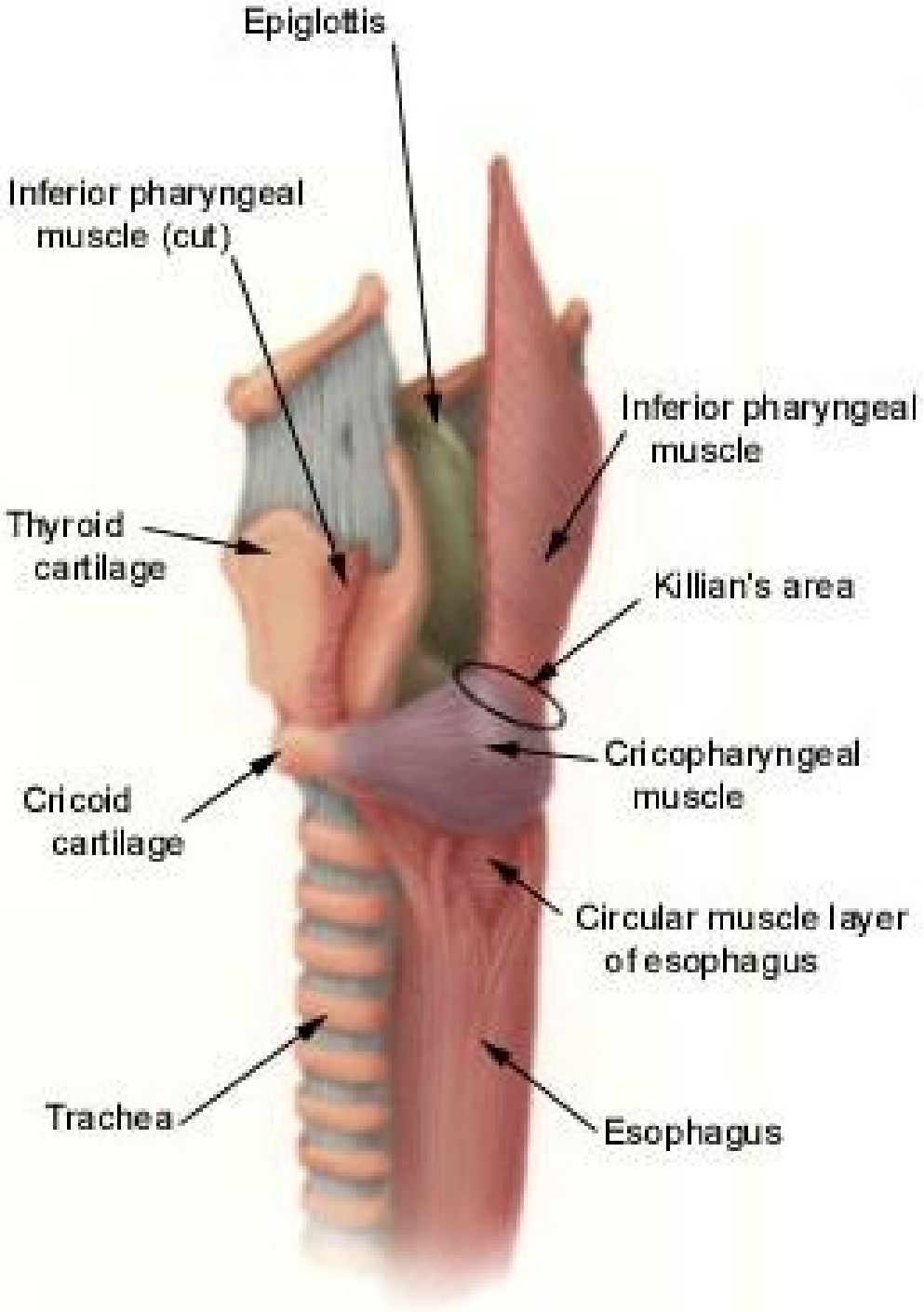
The Larynx: viewed from above

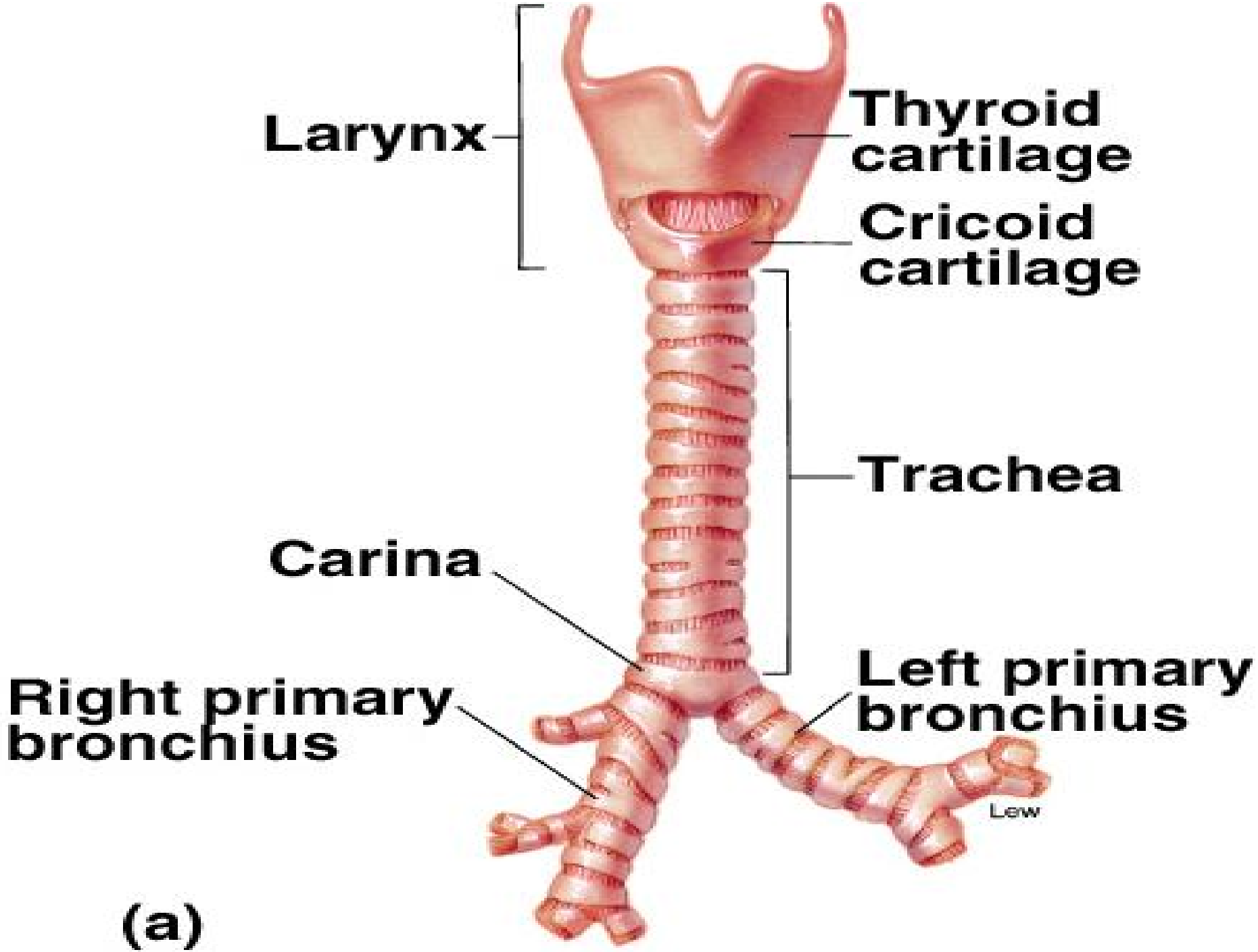
Vocal Folds

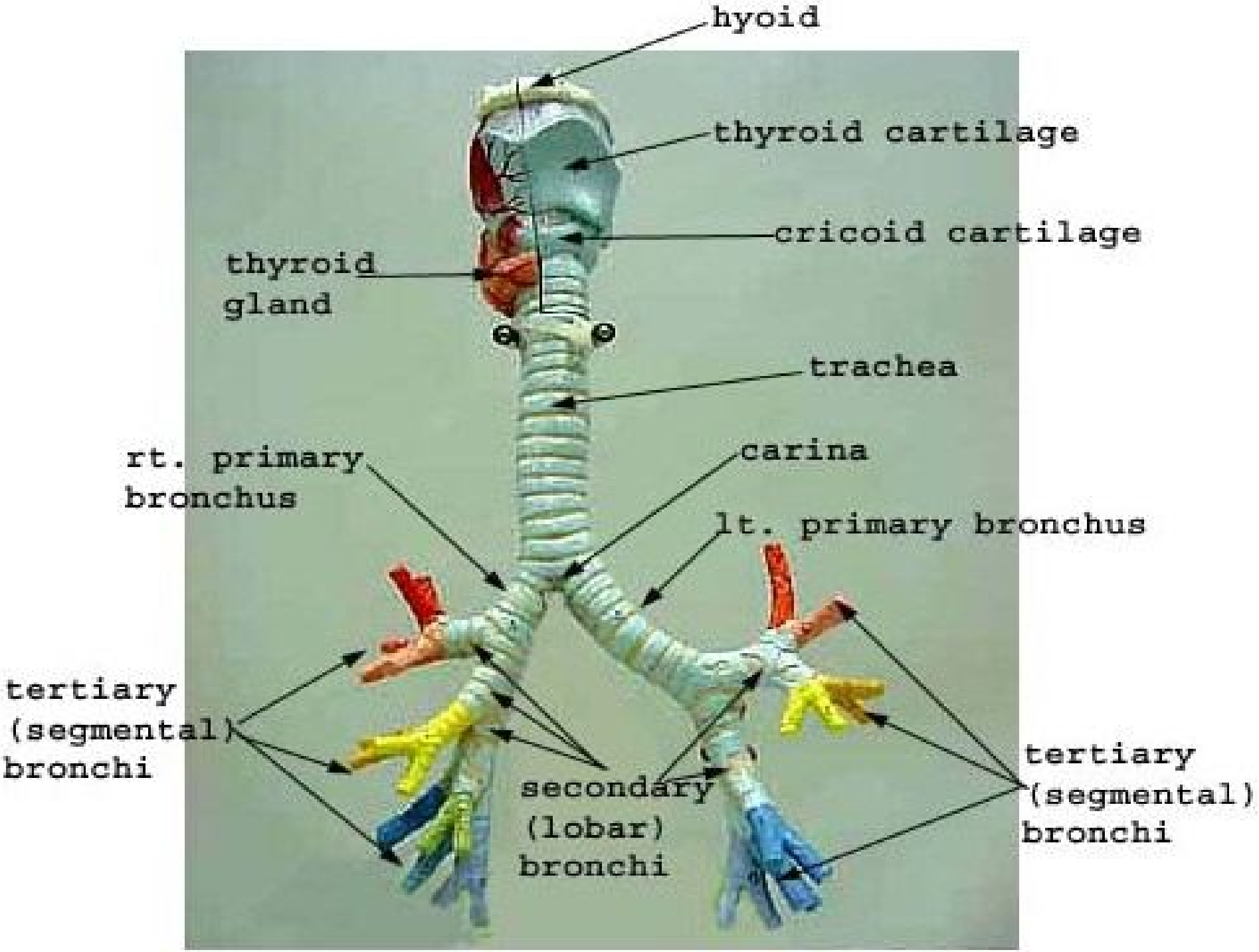

Corniculate cartilage
Glottis (open)
POSTERIOR
Glottis (closed)
Cuneiform cartilage
Aryepiglottic fold
Vestibular fold
Vocal fold
Epiglottis
Root of tongue
ANTERIOR

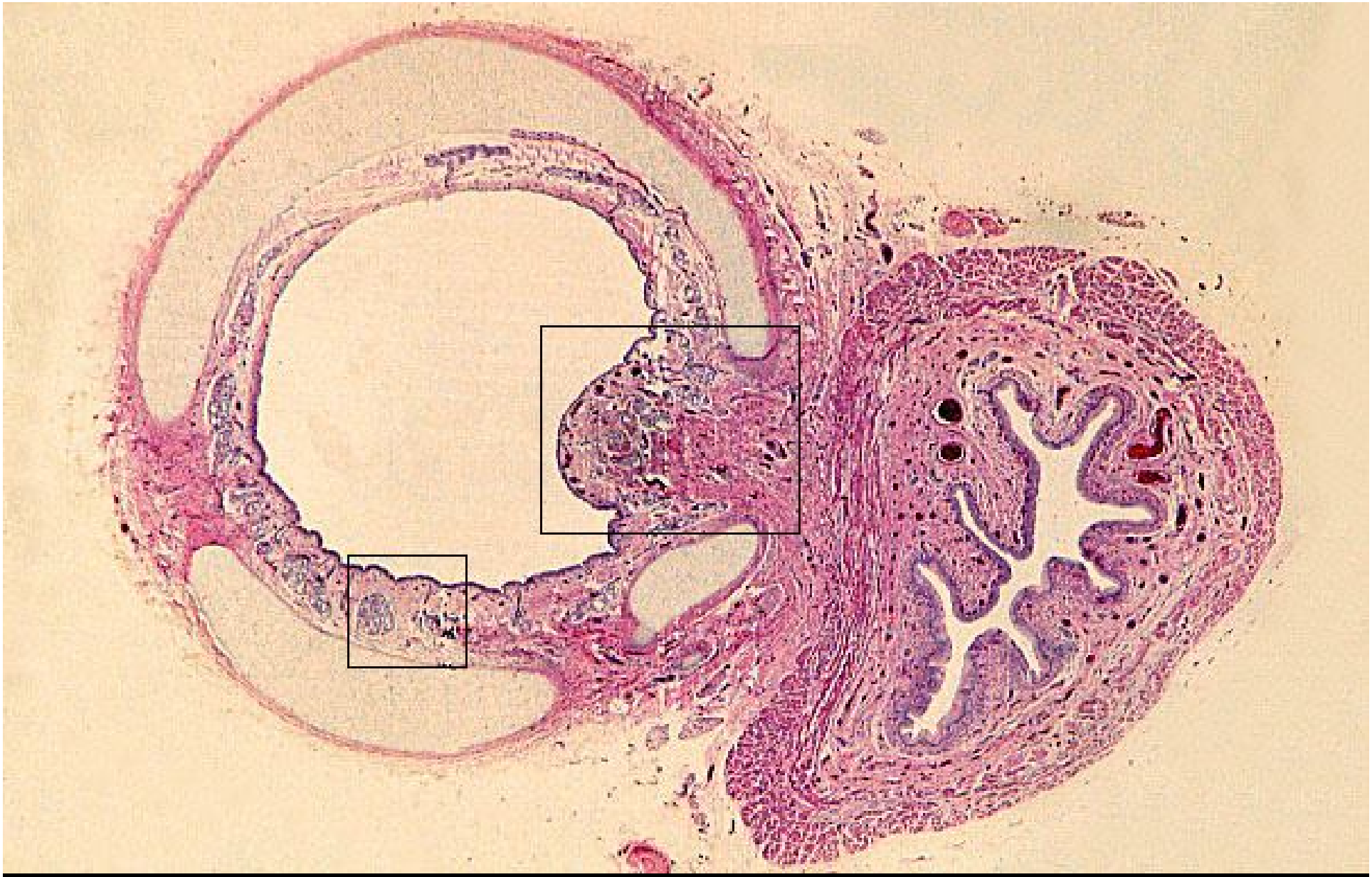
Trachea


Lumen of trachea
Hyaline cartilage
Ciliated epithelium
Moon
Smooth muscle
Connective tissue


Epiglottis
Inferior pharyngeal muscle (cut)
Inferior pharyngeal muscle
Thyroid cartilage
Killian's area
Cricopharyngeal muscle
Cricoid cartilage
Circular muscle layer of esophagus
Trachea
Esophagus

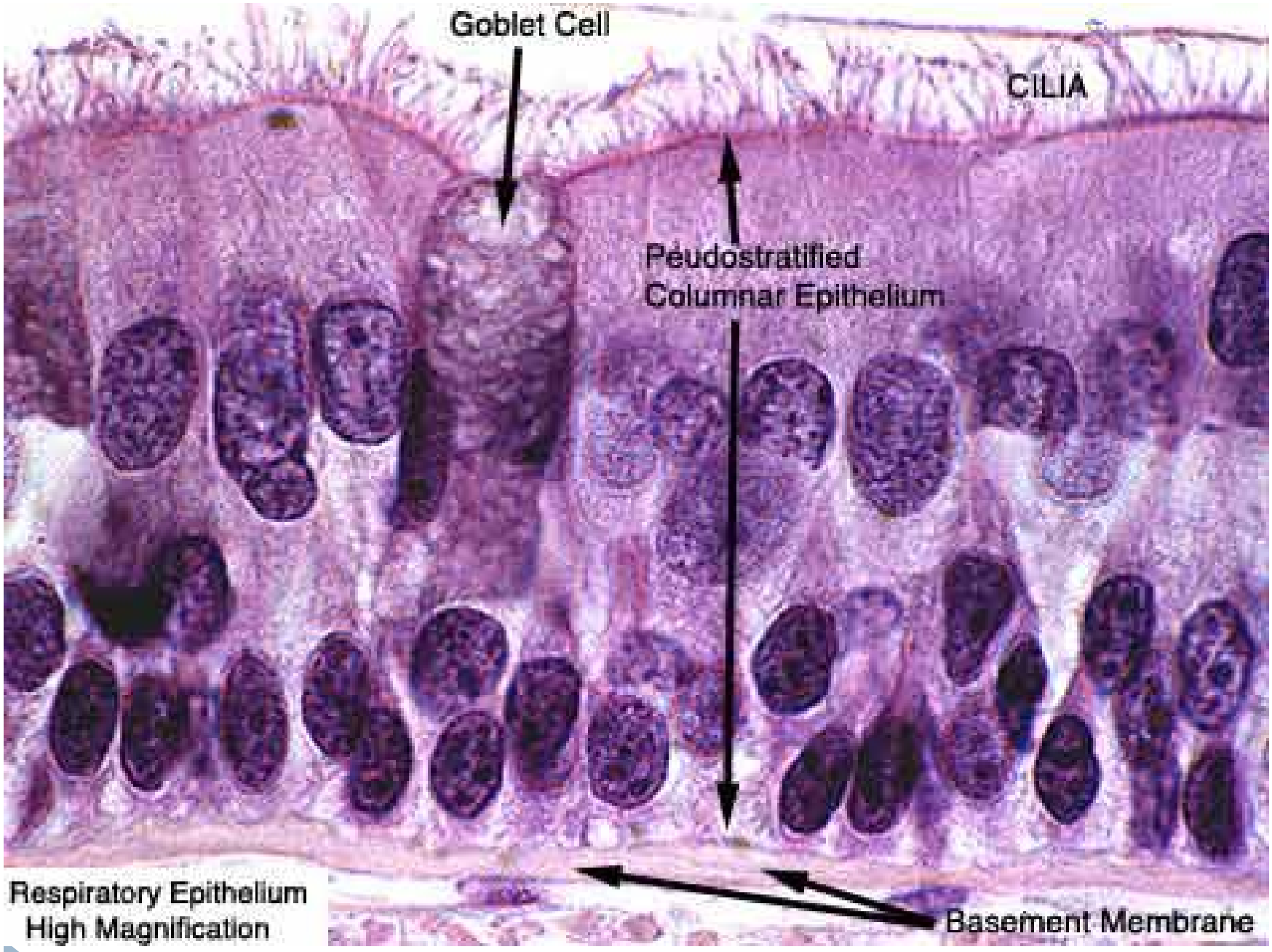

Larynx
Thyroid cartilage
Cricoid cartilage
Trachea
Carina
Left primary bronchius
Right primary bronchius
(a)

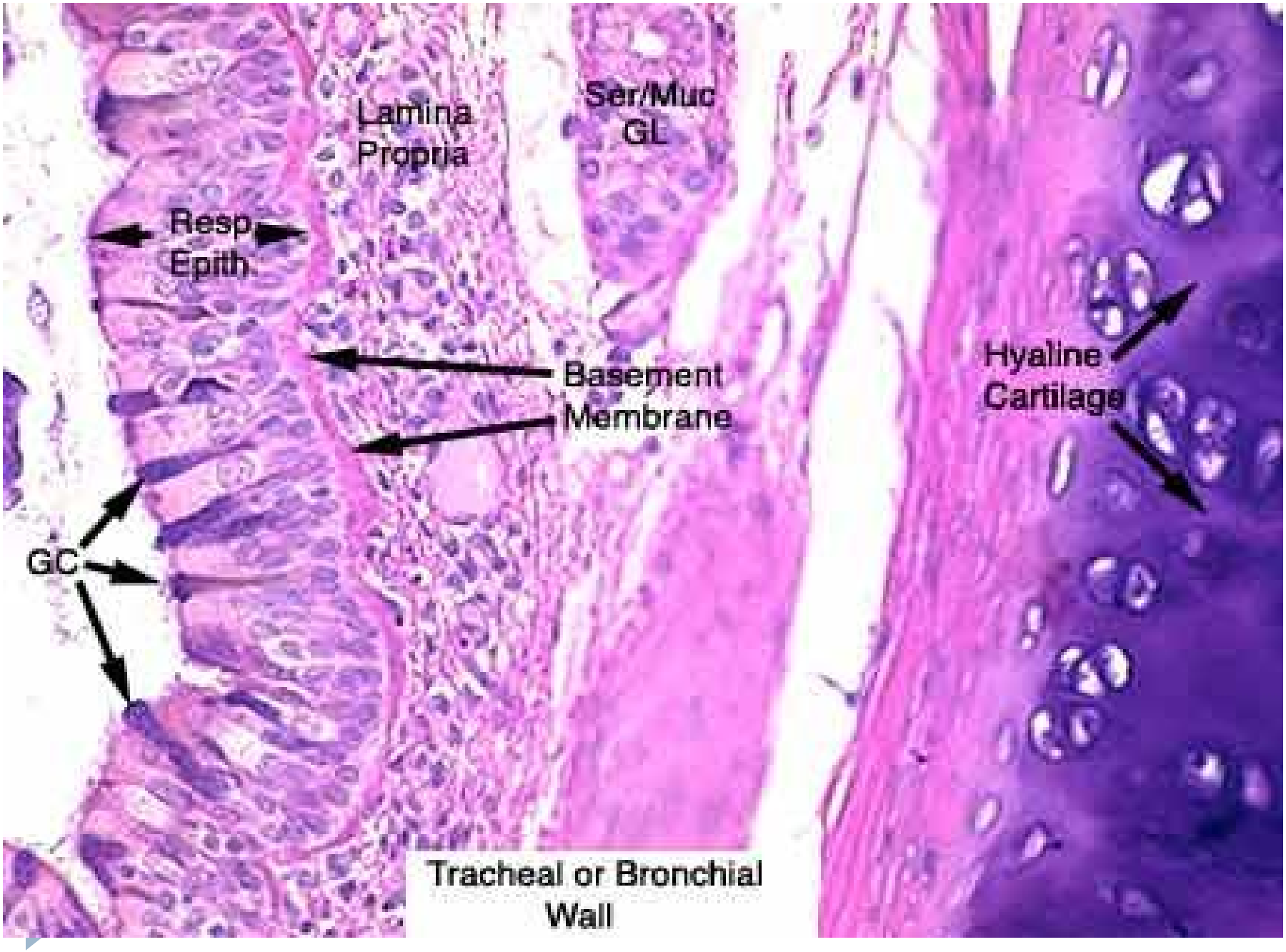

hyoid
thyroid cartilage
cricoid cartilage
thyroid gland
trachea
rt. primary bronchus
carina
lt. primary bronchus
tertiary (segmental) bronchi
secondary (lobar) bronchi
tertiary (segmental) bronchi

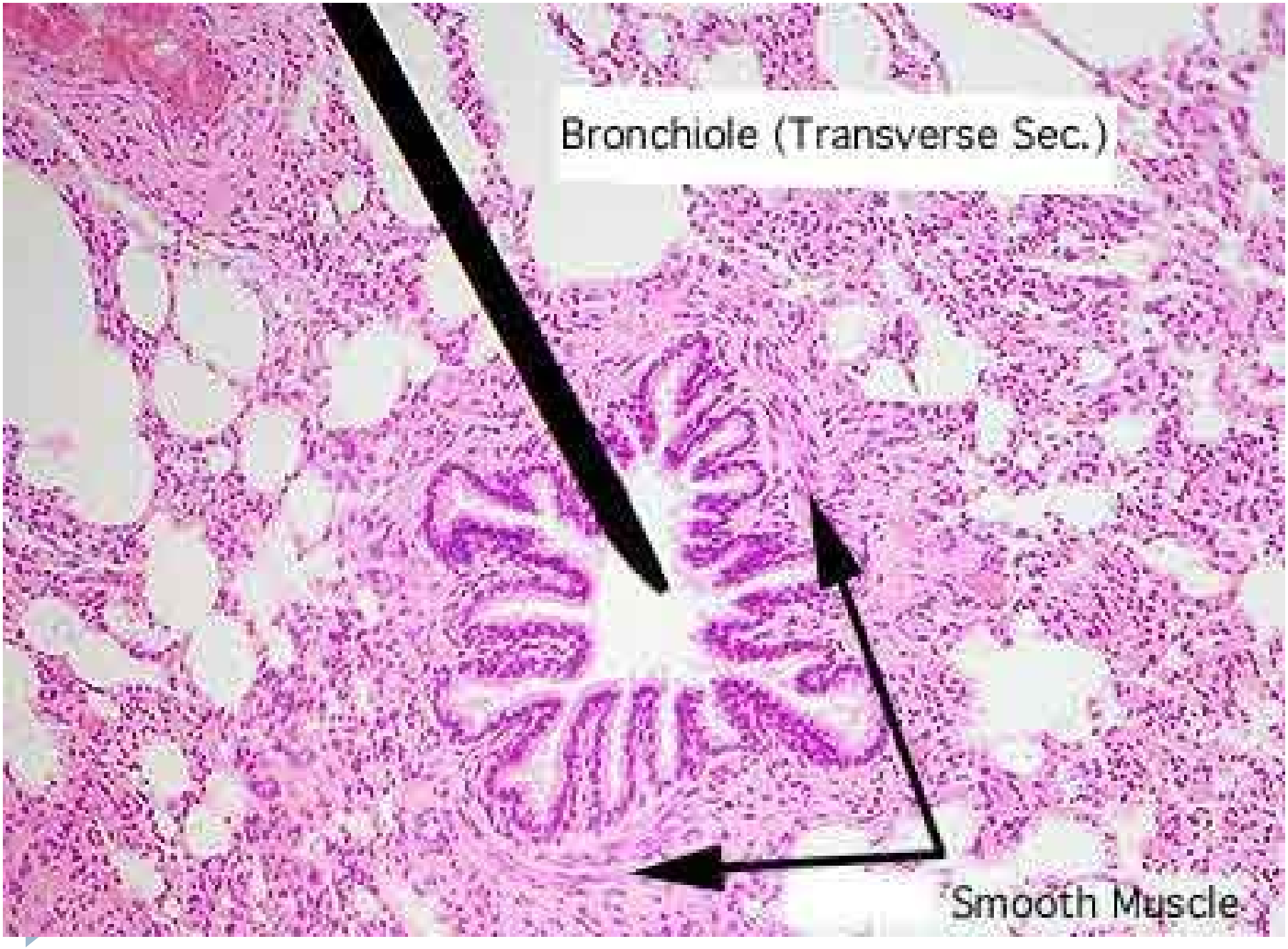


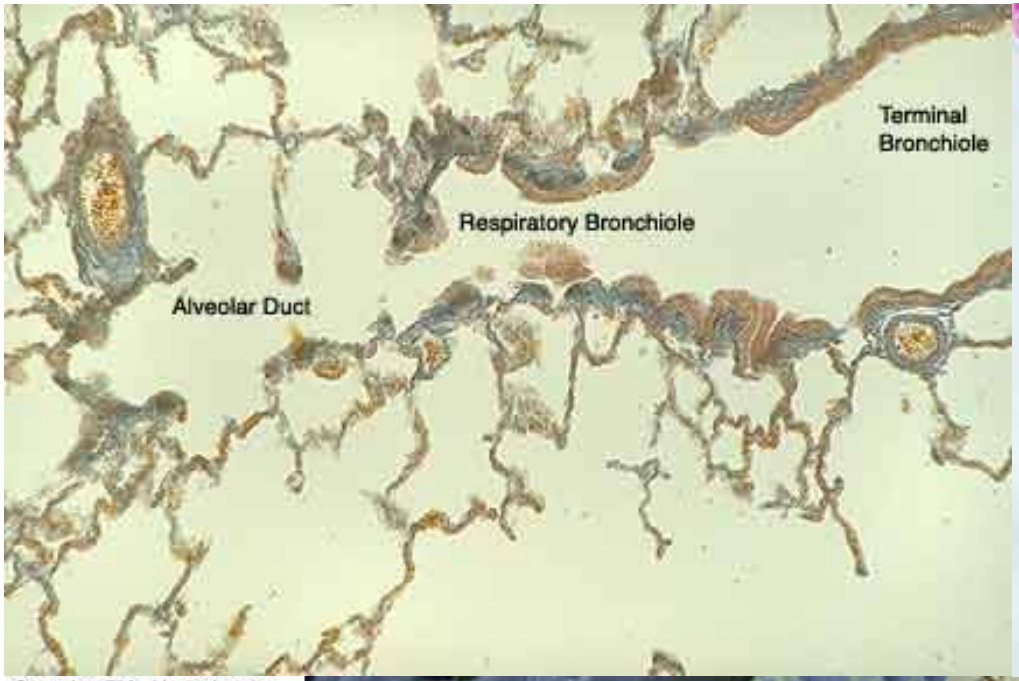
TRACHEA/ ESOPHAGUS

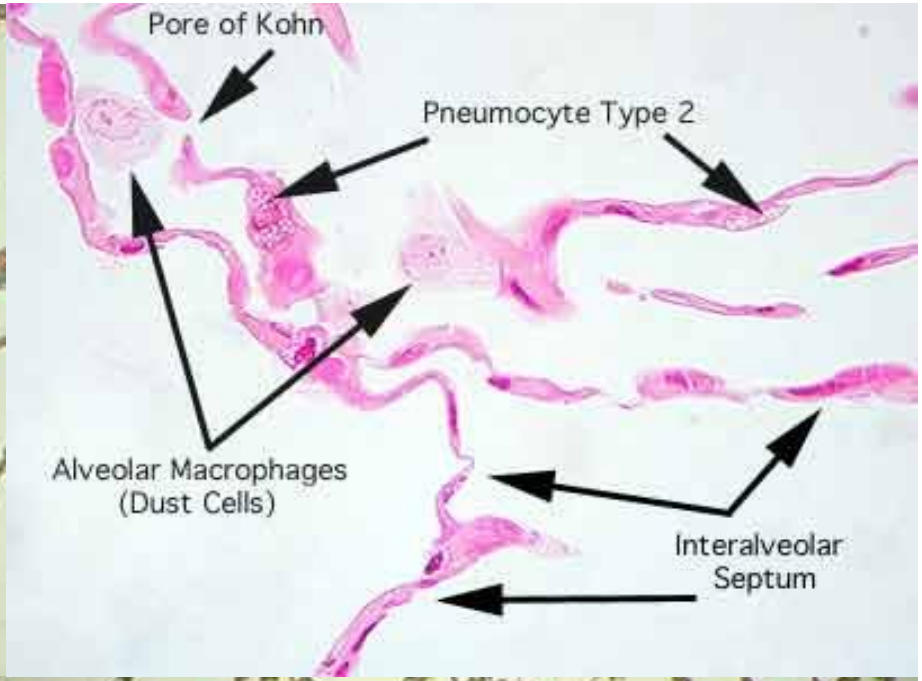

100 µm

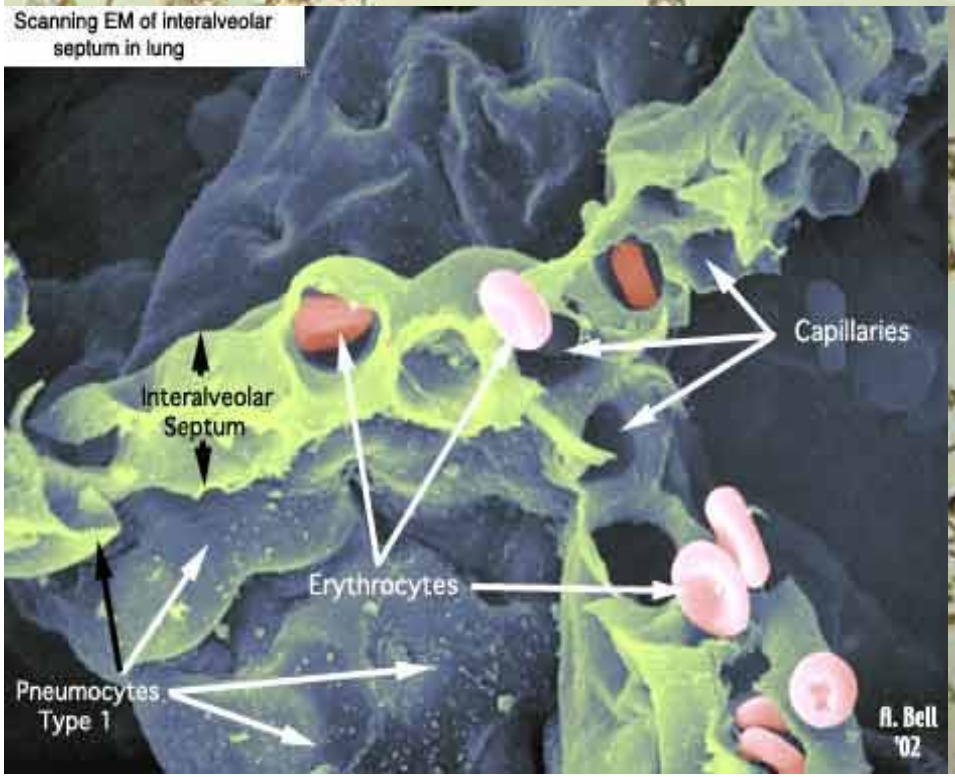

Goblet Cell
CILIA
Pseudostratified
Columnar Epithelium
Respiratory Epithelium
High Magnification
Basement Membrane

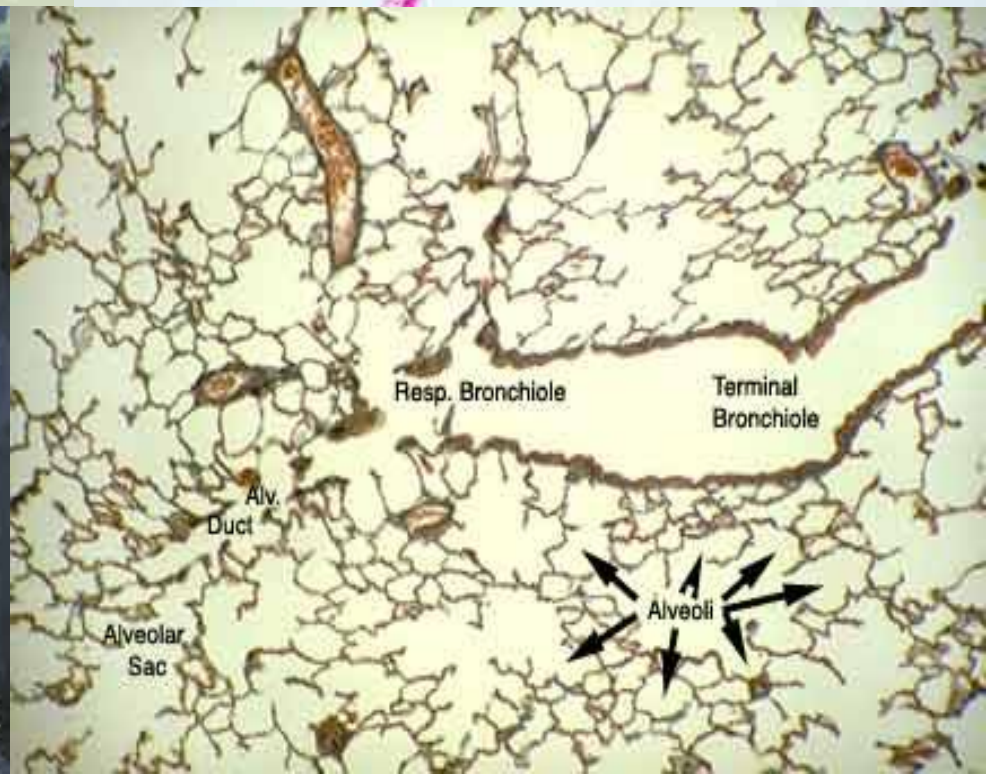

Lamina
Propria
Ser/Muc
GL
Resp
Epith.
Basement
Membrane
Hyaline
Cartilage
GC
Tracheal or Bronchial
Wall


Bronchiole (Transverse Sec.)
Smooth Muscle

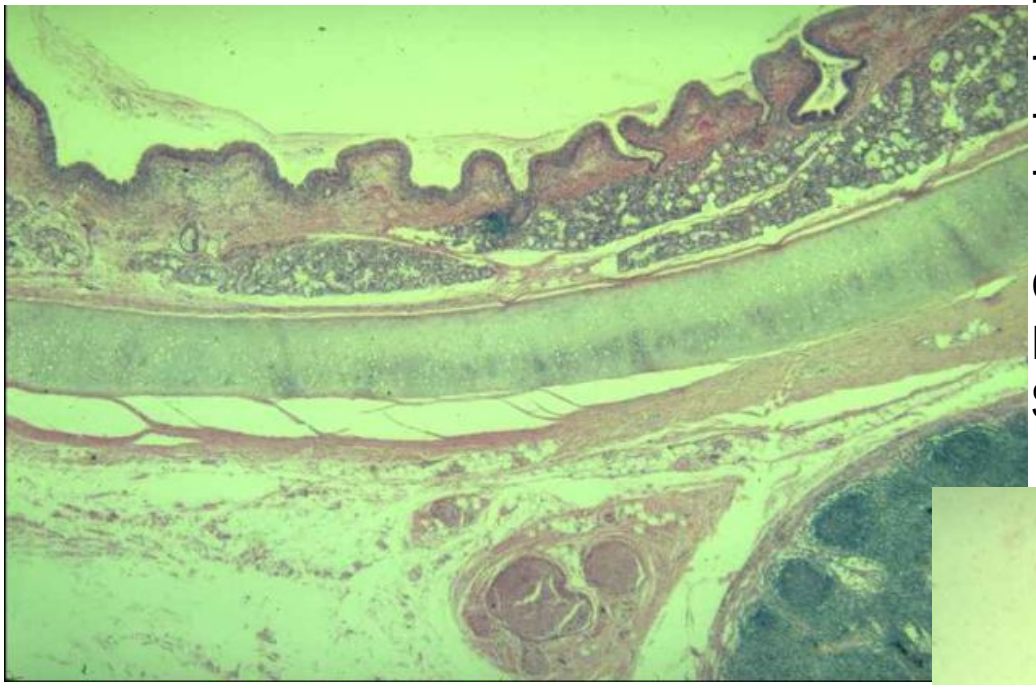

Terminal
Bronchiole
Respiratory Bronchiole
Alveolar Duct


Pore of Kohn
Pneumocyte Type 2
Alveolar Macrophages
(Dust Cells)
Interalveolar
Septum


Scanning EM of interalveolar
septum in lung
Capillaries
Interalveolar
Septum
Erythrocytes
Pneumocytes
Type 1
fl. Bell
'02


Resp. Bronchiole
Terminal
Bronchiole
Alv.
Duct
Alveoli
Alveolar
Sac

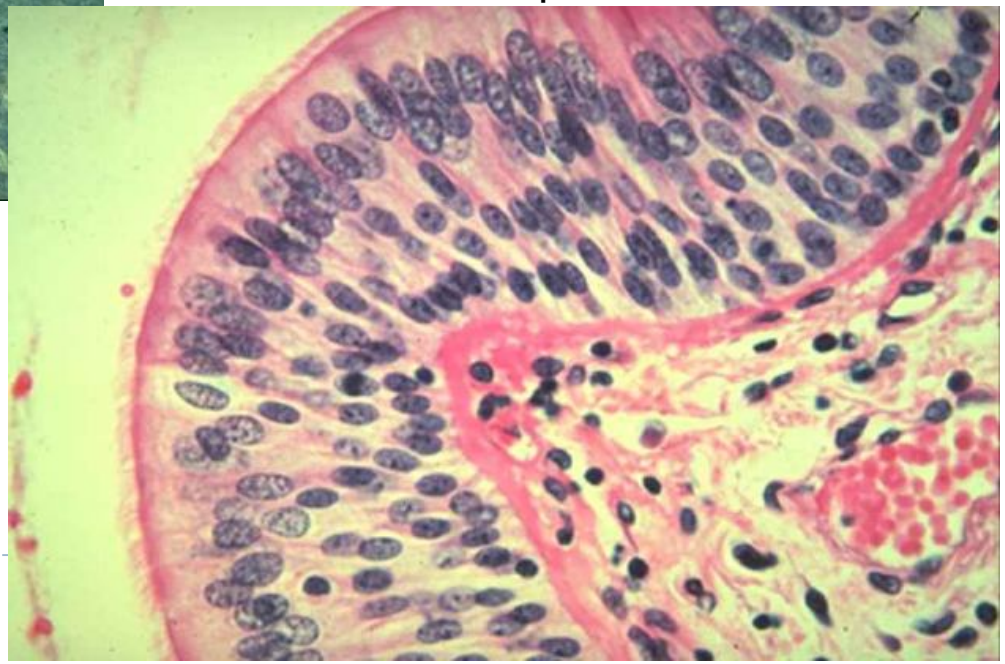
Trachea



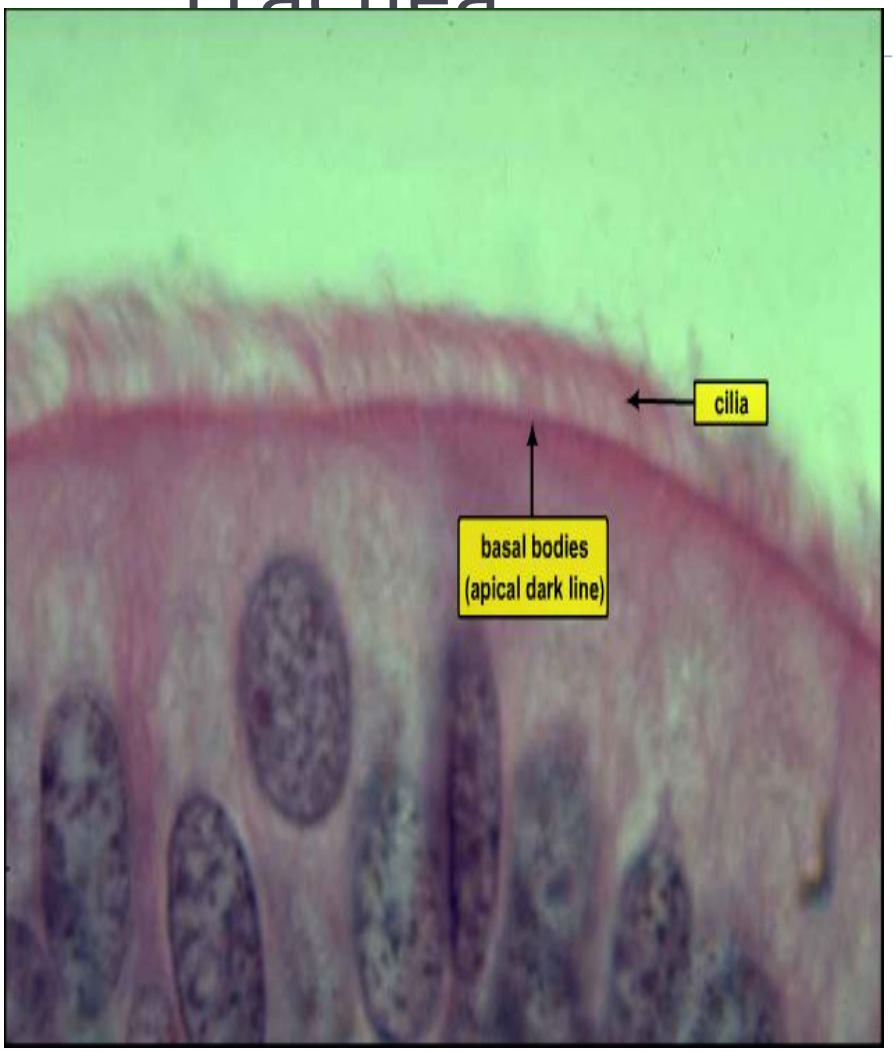
C-Shaped Cartilage
-maintains patency, especially during forced expiration

-Pseudostratified ciliated columnar epithelium
-Goblet cells
-Basal cells
-Brush cells

Glands:
Mucous- mucin
Serous- Glycoproteins, polysacharides & bacteriosidic proteins



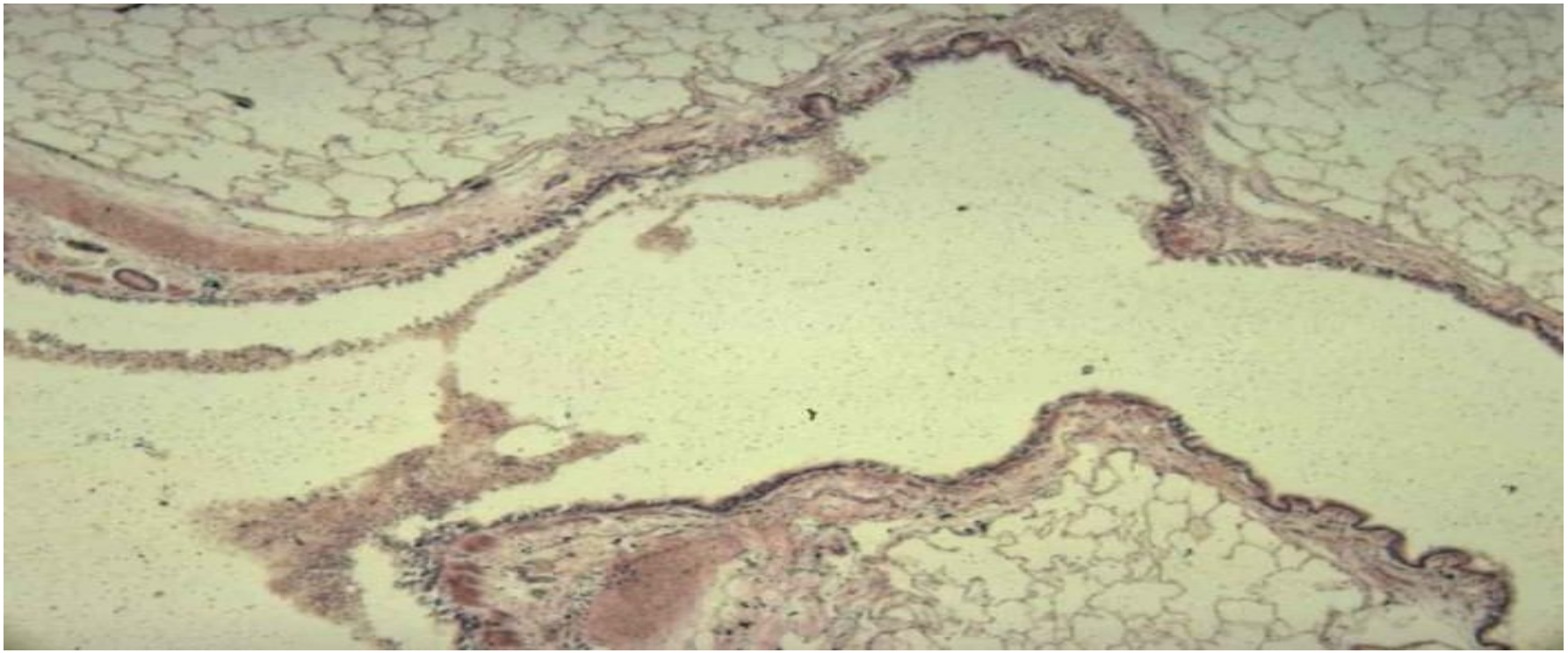
Trachea



Basal Bodies: Associated with cilia and highly eosinophilic

Mucous gland vs. serous gland

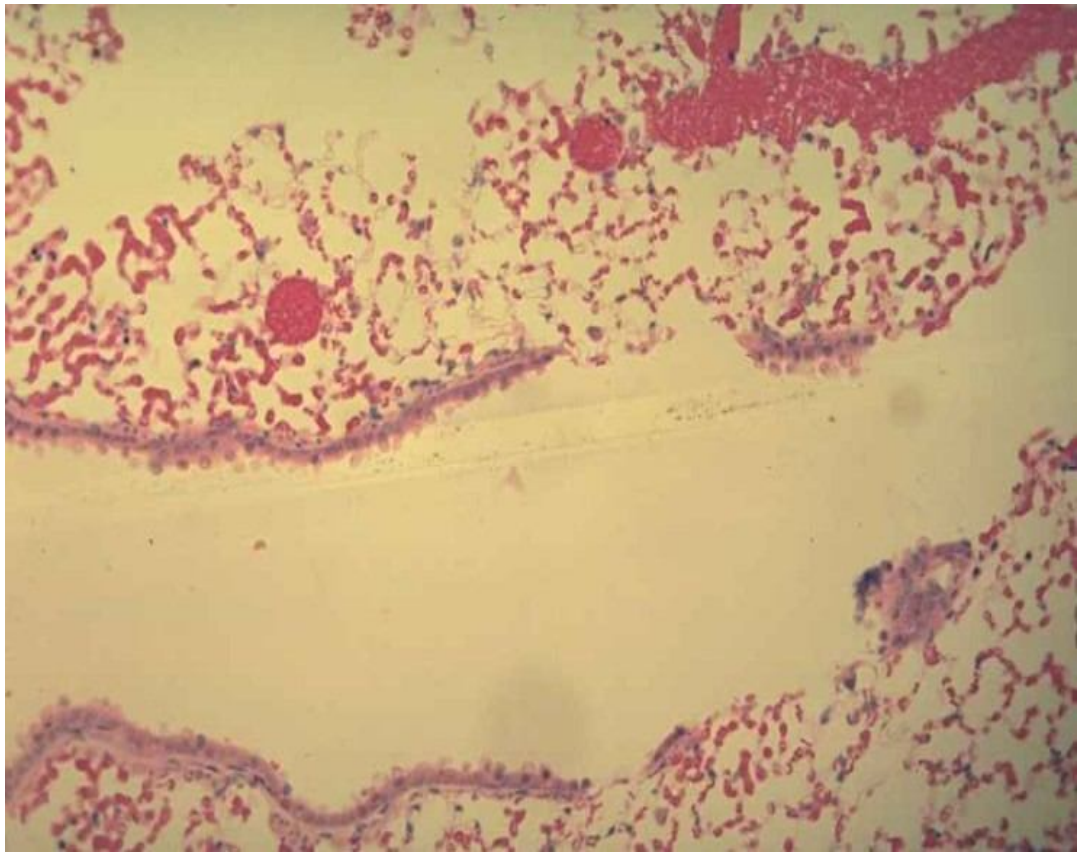
Bronchus – Bronchiole Junction



- Bronchus is the last place you'll see cartilage
- You still have smooth muscle in bronchioles
- Transition from pseudostratified to simple columnar

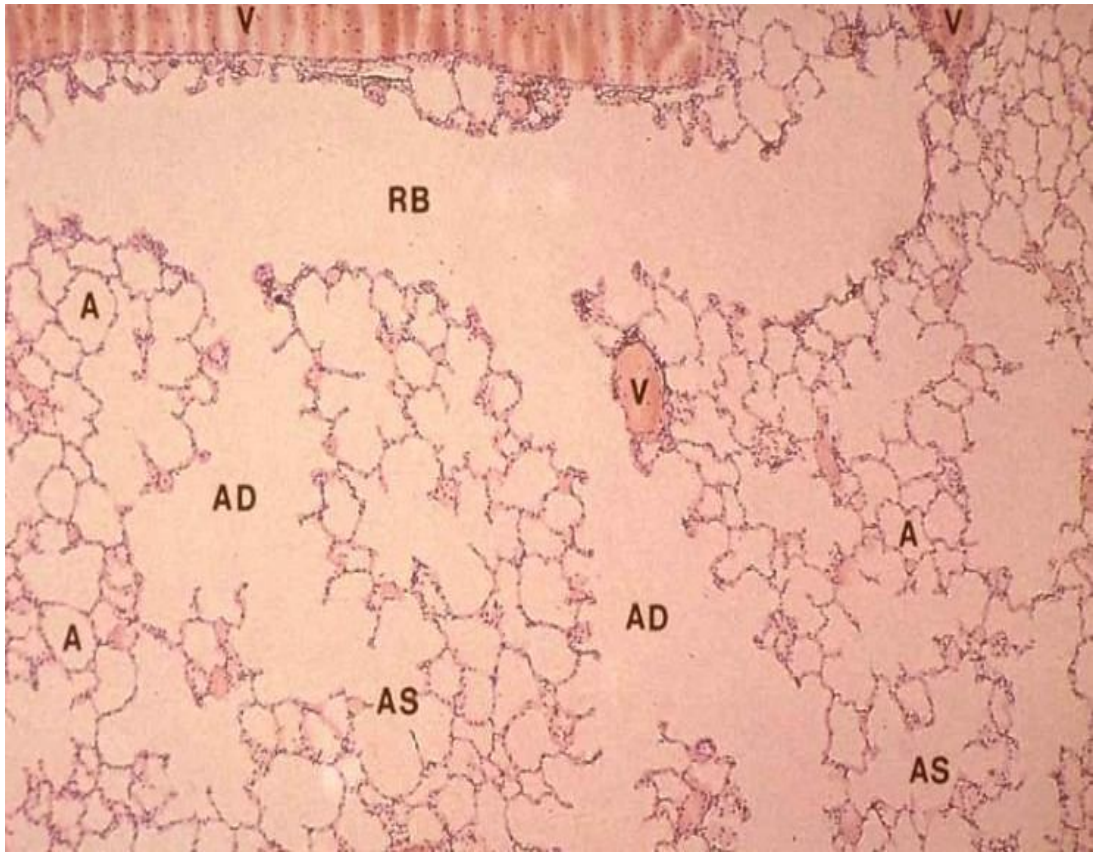
Conducting-Respiratory Junction

- The Respiratory segment begins w/ the respiratory bronchioles
  - Alveoli out-pocketings
  - Clara cells begin to predominate



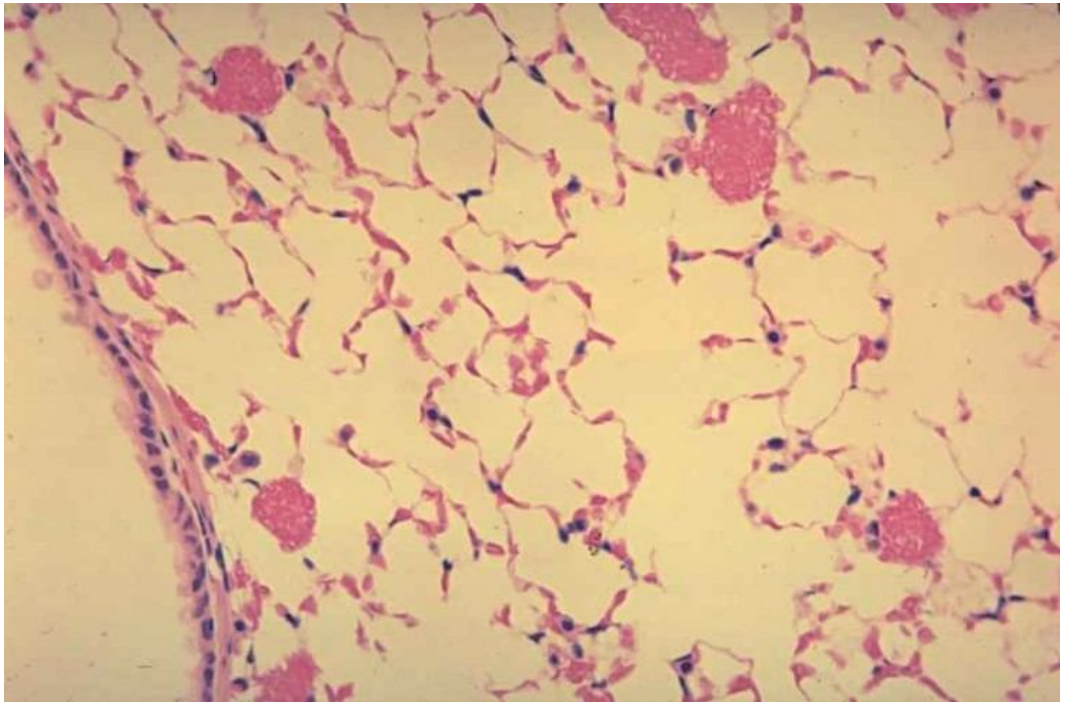
The Respiratory Segment

- Respiratory Bronchioles
  - Give off Alveoli
  - Give off alveolar ducts
- Alveolar ducts
  - Give off Alveoli only
- Alveolar sacs
  - Spaces surrounded by clusters of alveoli



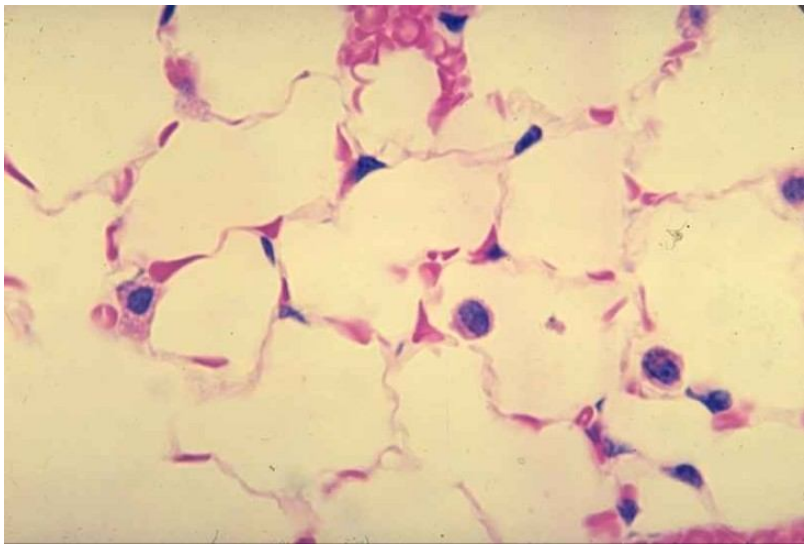
Identify the Segments . .

- Largest = Terminal Bronchiole
  - Simple epithelium
  - No Alveoli (i.e. not respiratory)
- Central clearing = Alveolar ducts
  - Give off Alveoli only



The Cells

- Type I Pneumocytes (epithelial cells)
- Type II Pneumocytes (Surfactant Cells)
  - secrete surfactant
  - BIG, at corners of alveoli
  - EM: Golgi and rER, laminar bodies of stored surfactant
- Macrophages (Dust)
  - within the alveolar space

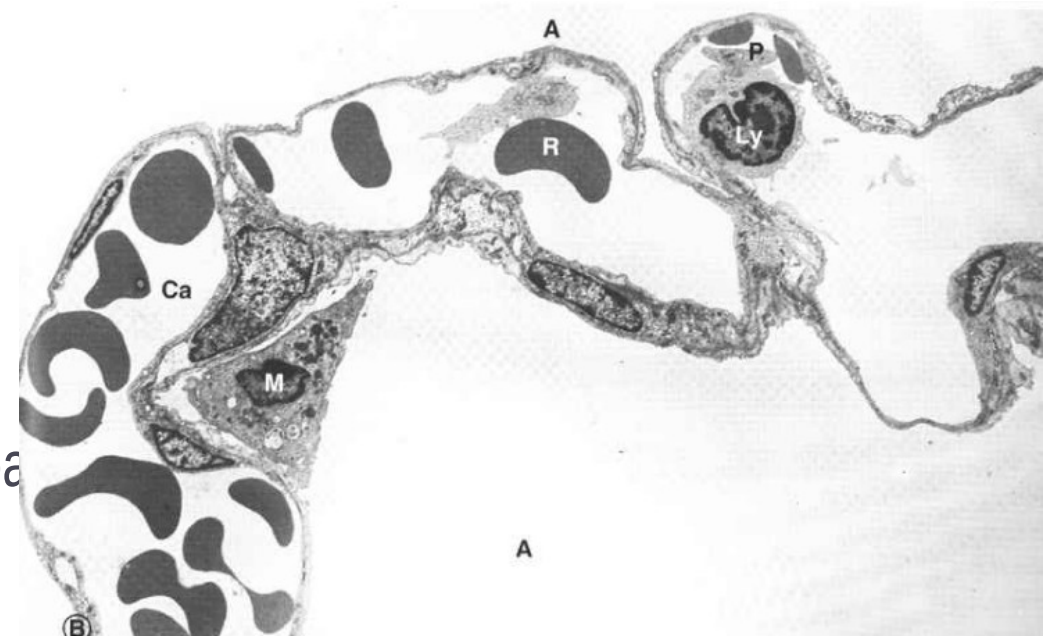


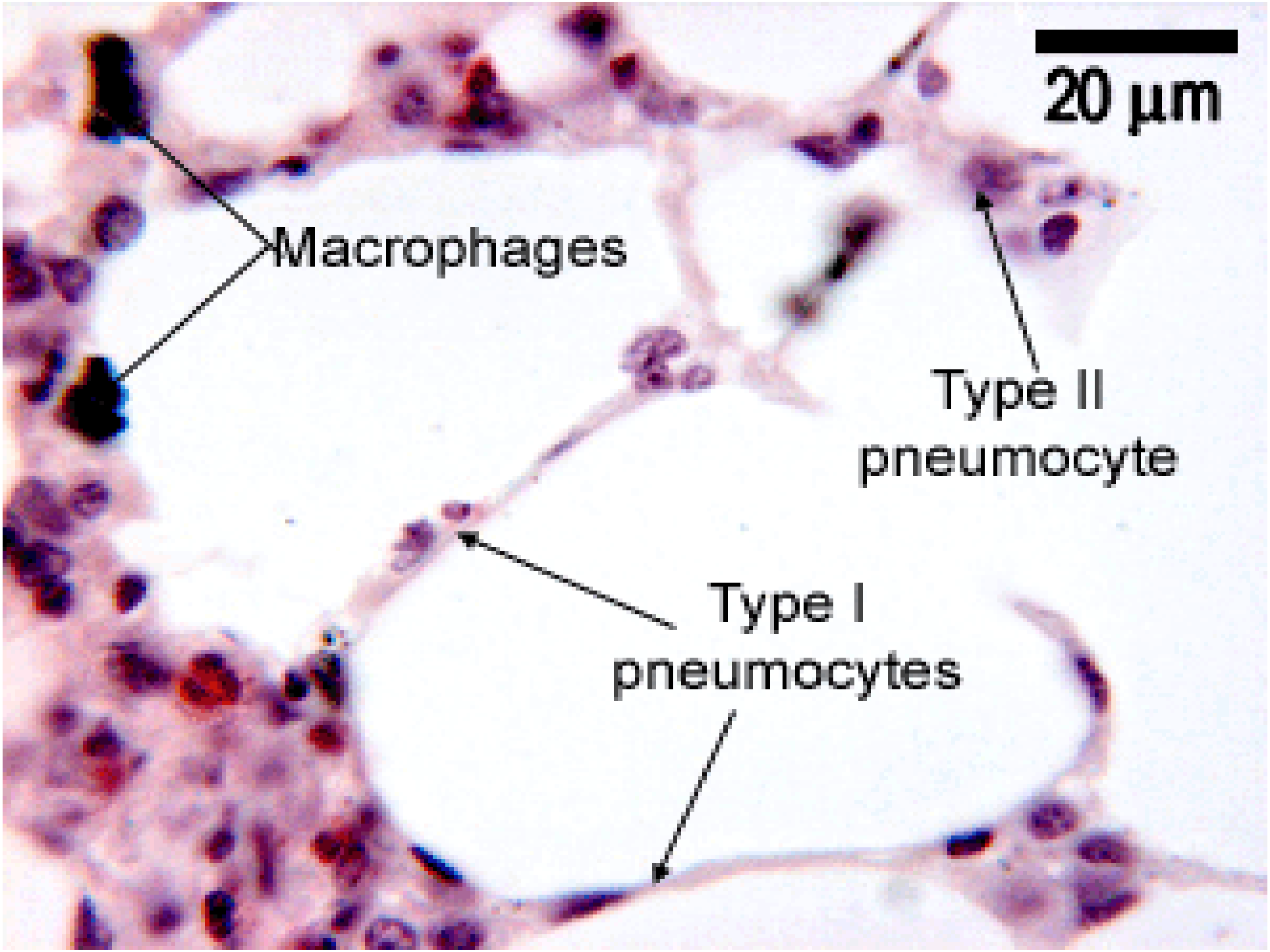
Elastic Tissue

- Elastin is present throughout the respiratory tract

The Gas Exchange

- Air Space
- Type I pneumocyte
- Blood Vessels
  - RBC's
- Macrophages
  - within the alveolar spa




20 µm
Macrophages
Type II
pneumocyte
Type I
pneumocytes

Respiratory Cycle