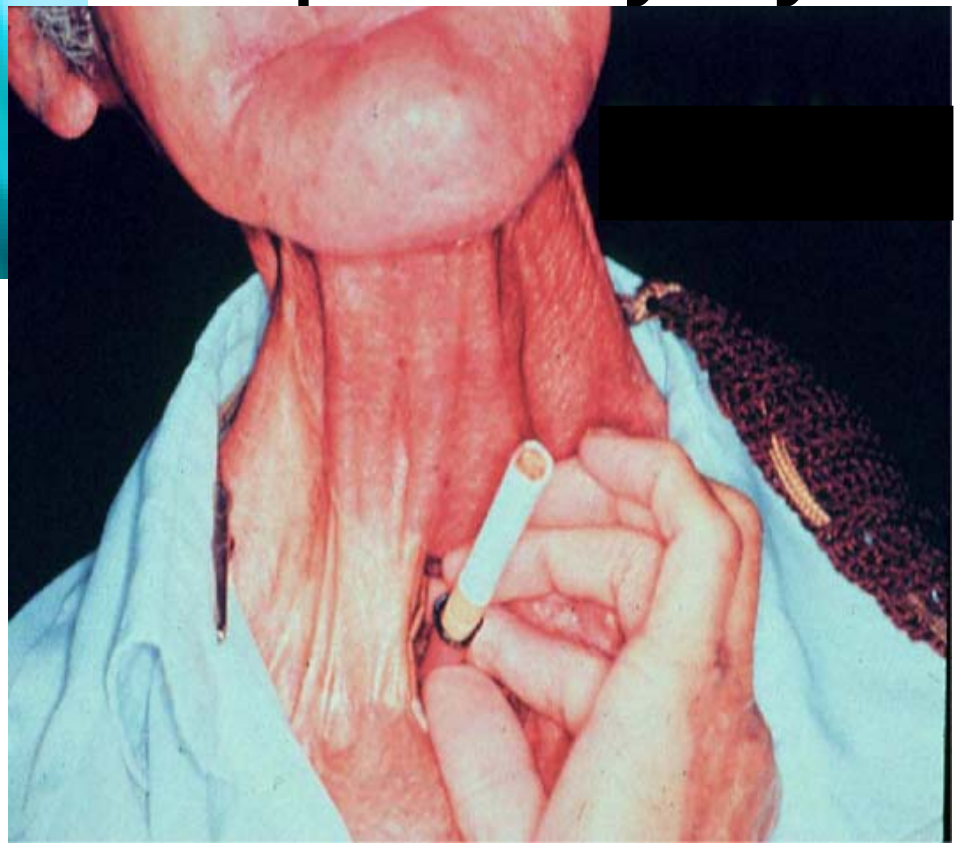
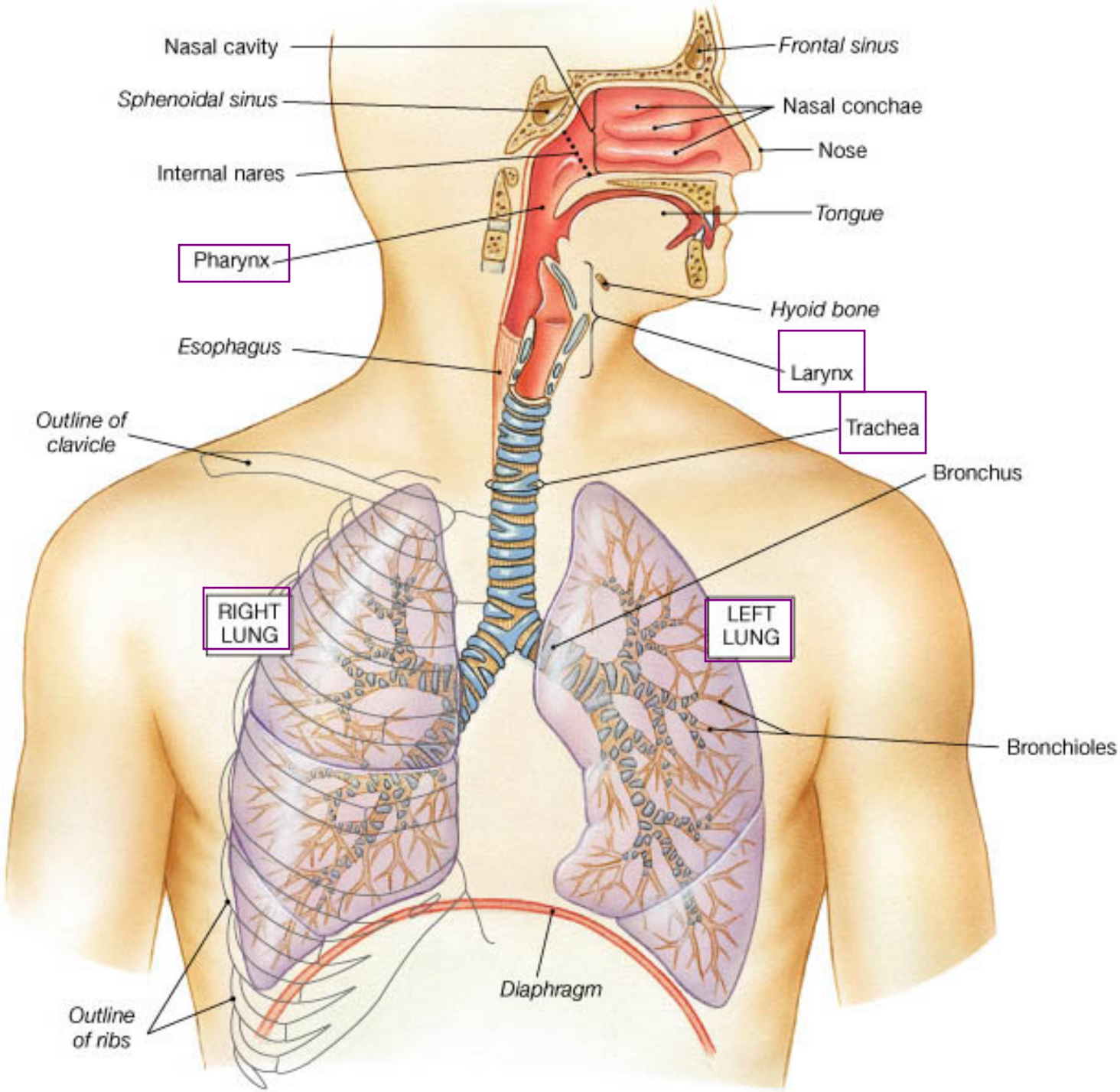
Respiratory system



Functions of the respiratory system

- Ventilation-air is warmed, humidify, filtered.
- Gas exchange- O_2 & CO_2
- Permit vocal communication
- Defend respiratory system from pathogens
- pH regulation of blood
  - Exhalation of CO_2

Fig 24.1


Nasal cavity
Frontal sinus
Sphenoidal sinus
Nasal conchae
Internal nares
Nose
Tongue
Pharynx
Hyoid bone
Esophagus
Larynx
Trachea
Outline of clavicle
Bronchus
RIGHT LUNG
LEFT LUNG
Bronchioles
Outline of ribs
Diaphragm

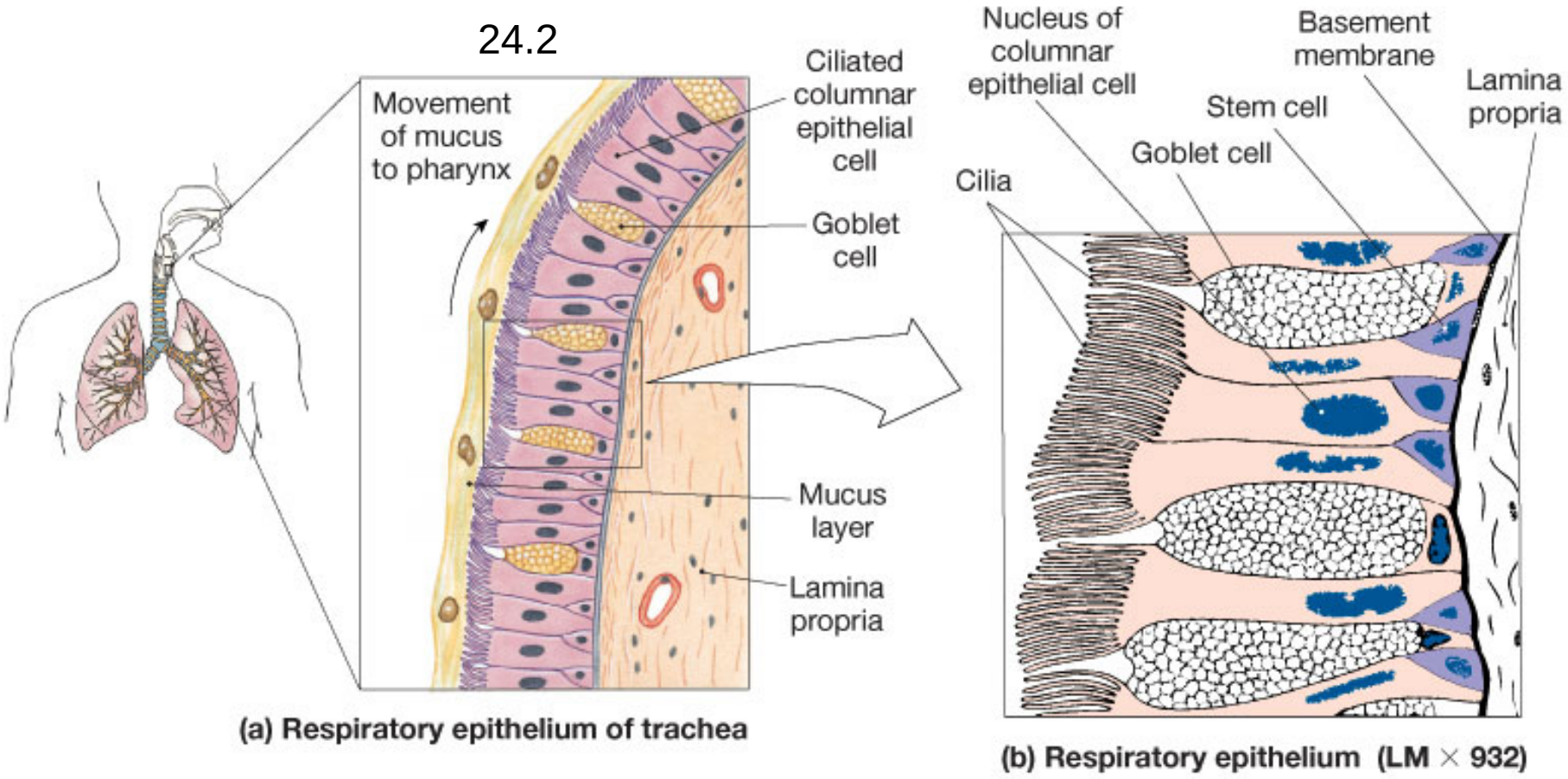
- Conduction zone
  - Ventilation of air-movement of air from the environment towards the alveoli
  - Humidify & cleans air
  - Environment > terminal bronchioles
- Respiratory zone
  - Gas exchange at the alveoli
  - Respiratory bronchioles > alveoli

Respiratory Epithelium

- Lines majority of respiratory tract
- Pseudostratified ciliated columnar epithelium (PSCC) with many goblet cells
  - Produces mucus to trap foreign particles
- Lamina propria (connective tissue layer)
  - Epithelium and lamina propria = mucus membrane

cilia rhythmically ‘sweeps’ debris up to be swallowed at pharynx

Fig 24.2



The Nose

- Primary airway for respiration
- Moistens and warms air
- Filters inhaled air (mucus)
- Resonating chamber for speech
- Houses olfactory receptors

- It would be healthier to smoke cigarettes through the nose!

- External nares
  - Open into nasal cavity
  - nose hairs
- Nasal cavity
  - Superior, middle and inferior meati
    - Narrow grooves and conchal surfaces (ethmoid bone)
  - Hard palate-divides nasal and oral cavities
  - Internal nares
    - Between nasal cavity and nasopharynx

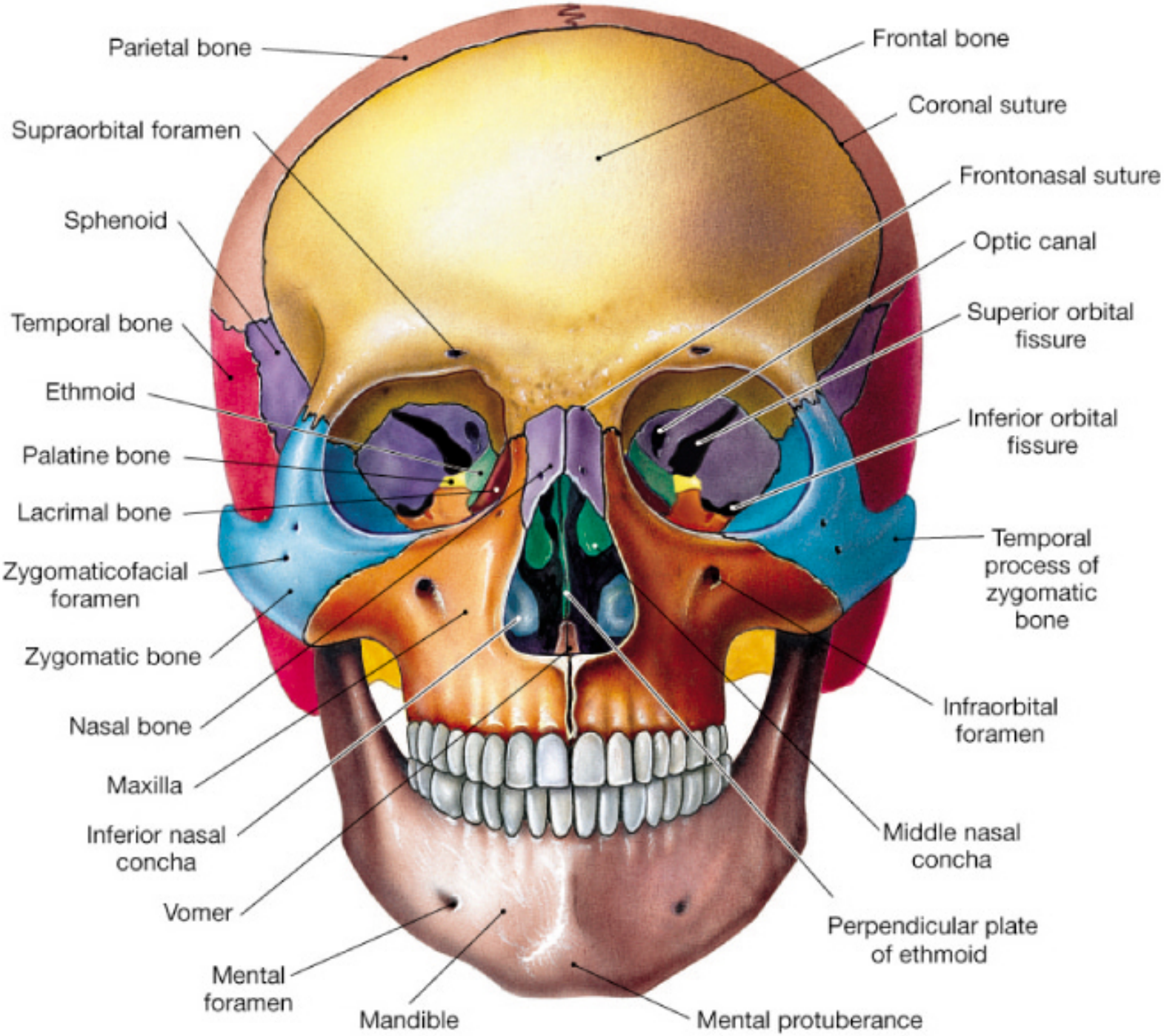
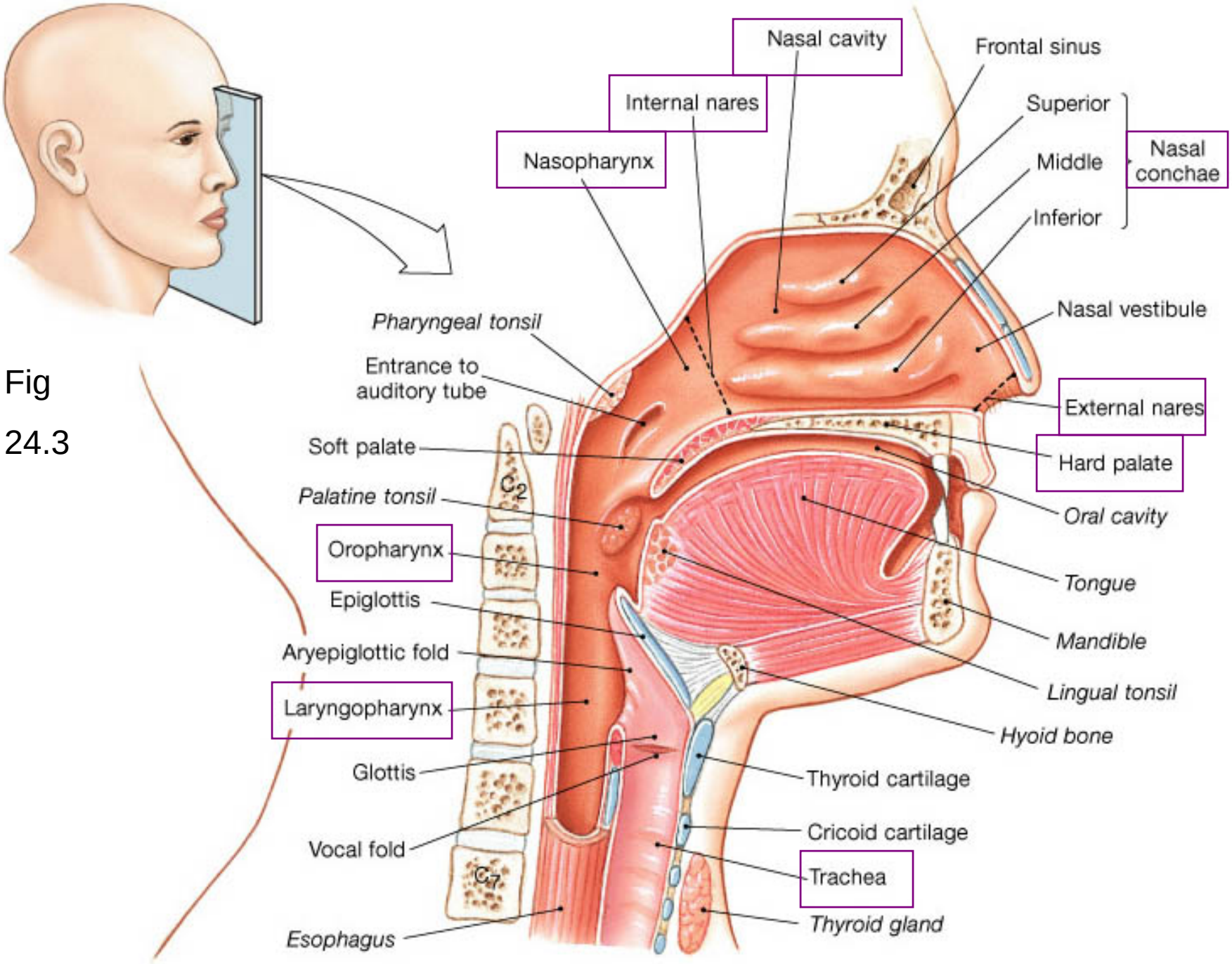
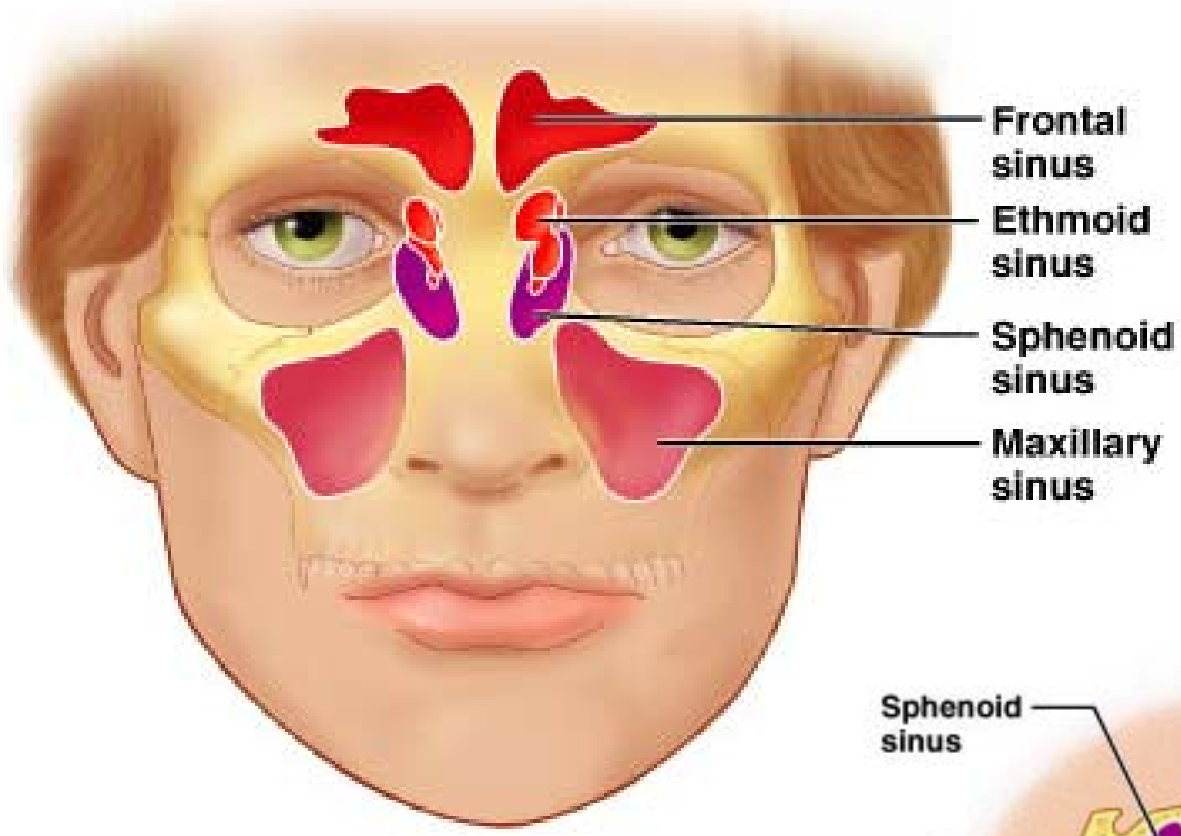

Parietal bone
Frontal bone
Coronal suture
Supraorbital foramen
Frontonasal suture
Sphenoid
Optic canal
Temporal bone
Superior orbital fissure
Ethmoid
Inferior orbital fissure
Palatine bone
Lacrimal bone
Temporal process of zygomatic bone
Zygomaticofacial foramen
Zygomatic bone
Infraorbital foramen
Nasal bone
Maxilla
Middle nasal concha
Inferior nasal concha
Vomer
Perpendicular plate of ethmoid
Mental foramen
Mandible
Mental protuberance

Fig 24.3

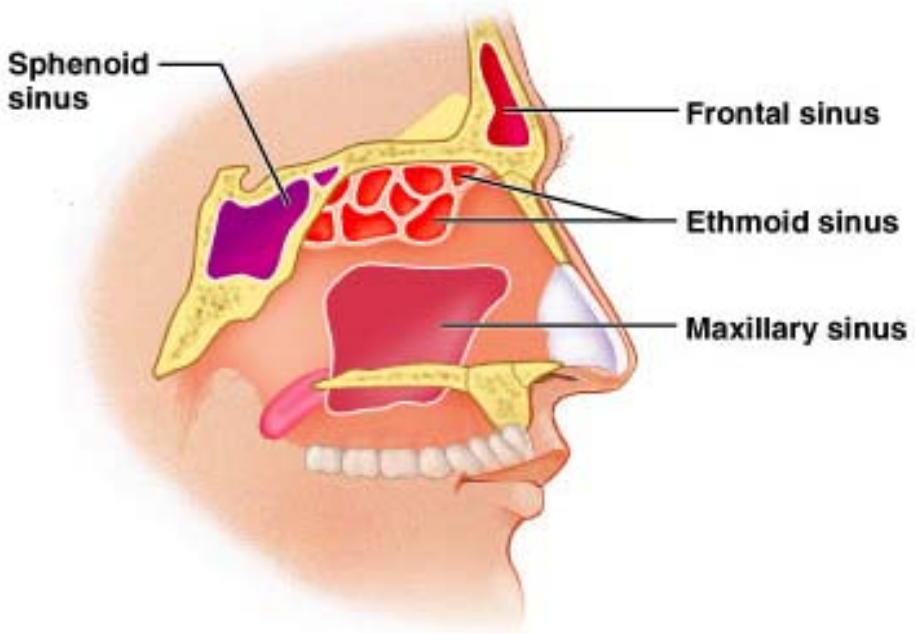


(d) Sagittal section

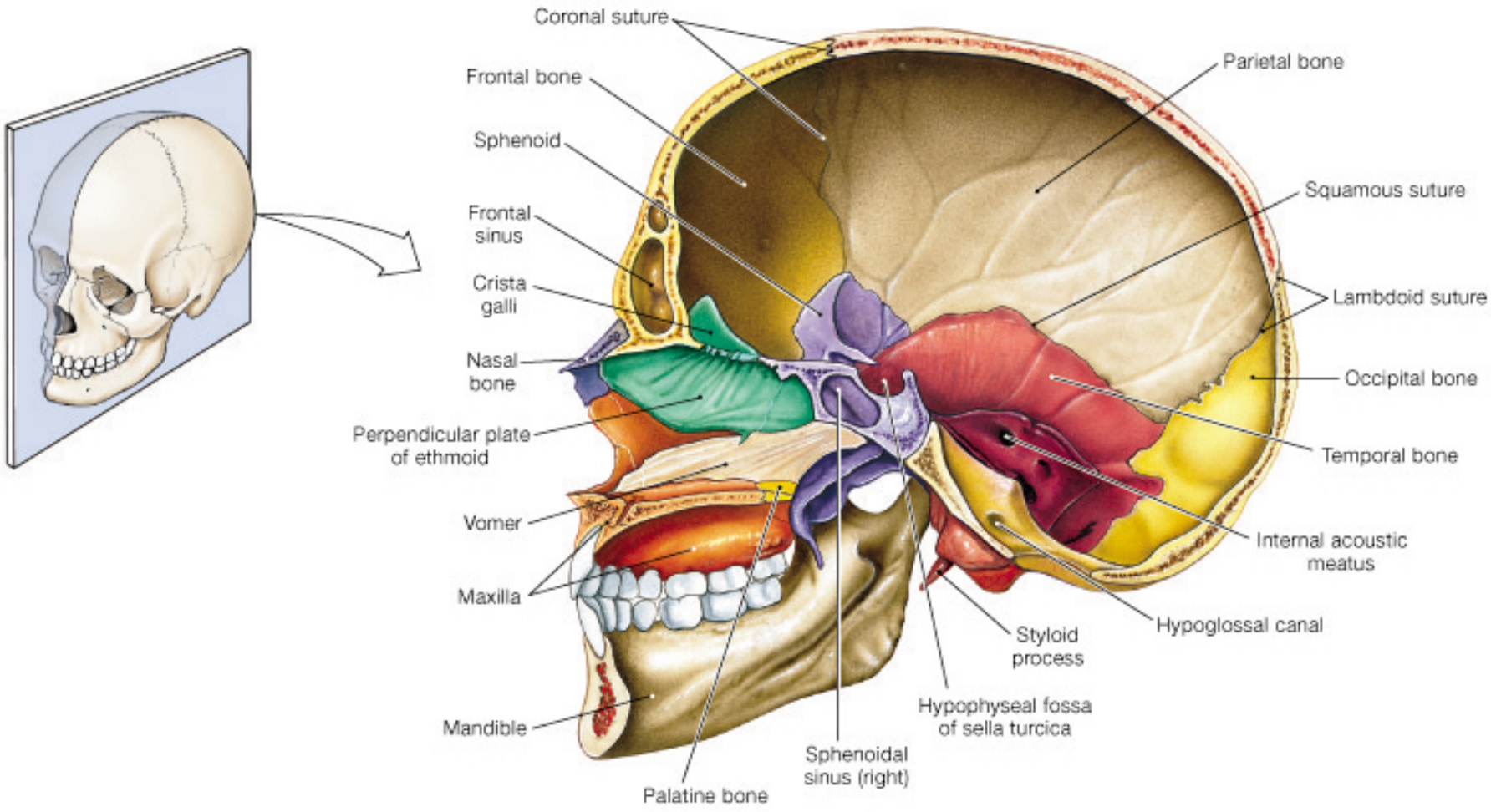


(a)

PARANASAL SINUSES



(b)


Coronal suture
Frontal bone
Sphenoid
Frontal sinus
Crista galli
Nasal bone
Perpendicular plate of ethmoid
Vomer
Maxilla
Mandible
Palatine bone
Sphenoidal sinus (right)
Hypophyseal fossa of sella turcica
Styloid process
Hypoglossal canal
Internal acoustic meatus
Temporal bone
Occipital bone
Lambdoid suture
Squamous suture
Parietal bone

The Pharynx

Shared by digestive and respiratory systems

Nasopharynx

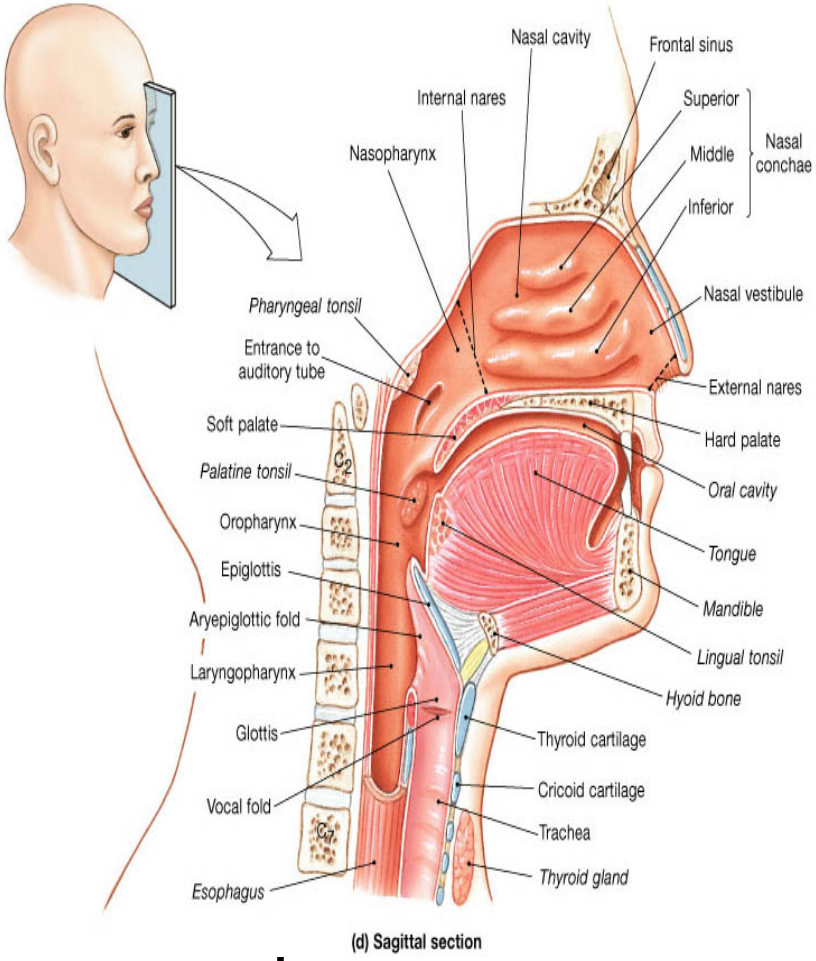
from Internal nares to uvula.

Oropharynx

From soft palate to the epiglottis

Laryngopharynx

Between hyoid and entrance to esophagus



Nasopharynx

- Only an air passageway
- Closed off during swallowing
- Pharyngeal tonsil-(lymphatic system)
- Contains the opening to the auditory tube (special senses)

Oropharynx

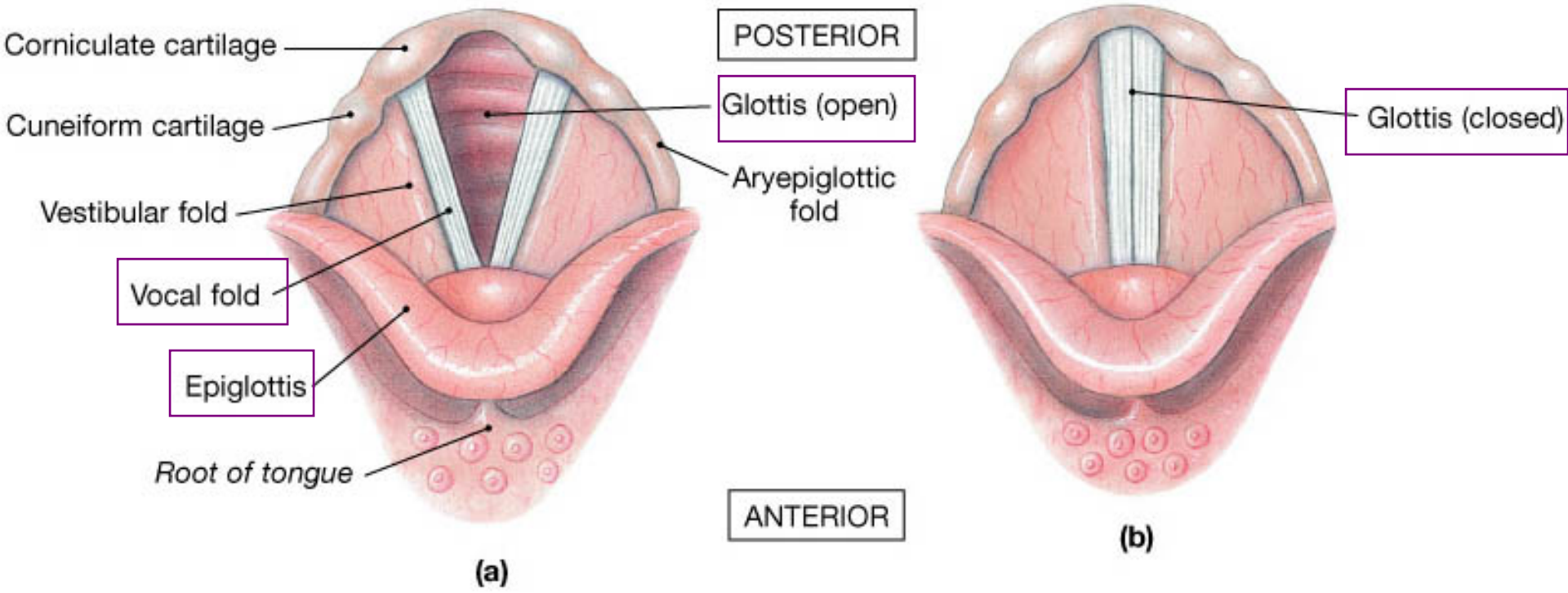
- Extends from soft palate to the epiglottis
- Epithelium is stratified squamous epithelium
- Two types of tonsils in the oropharynx
  - Palatine tonsils
  - Lingual tonsils

Laryngopharynx

- Passageway for both food and air
- Continuous with the esophagus and larynx

Fig 24.5 Larynx & vocal cords

The length & thickness of the vocal folds help determine the sound of one's voice



Trachea

- From C_6 to T_5
- “C” rings of cartilage
  - Tracheal cartilages
  - Stiffen tracheal walls and protect airway
  - Posterior wall distorts allowing food passage through esophagus

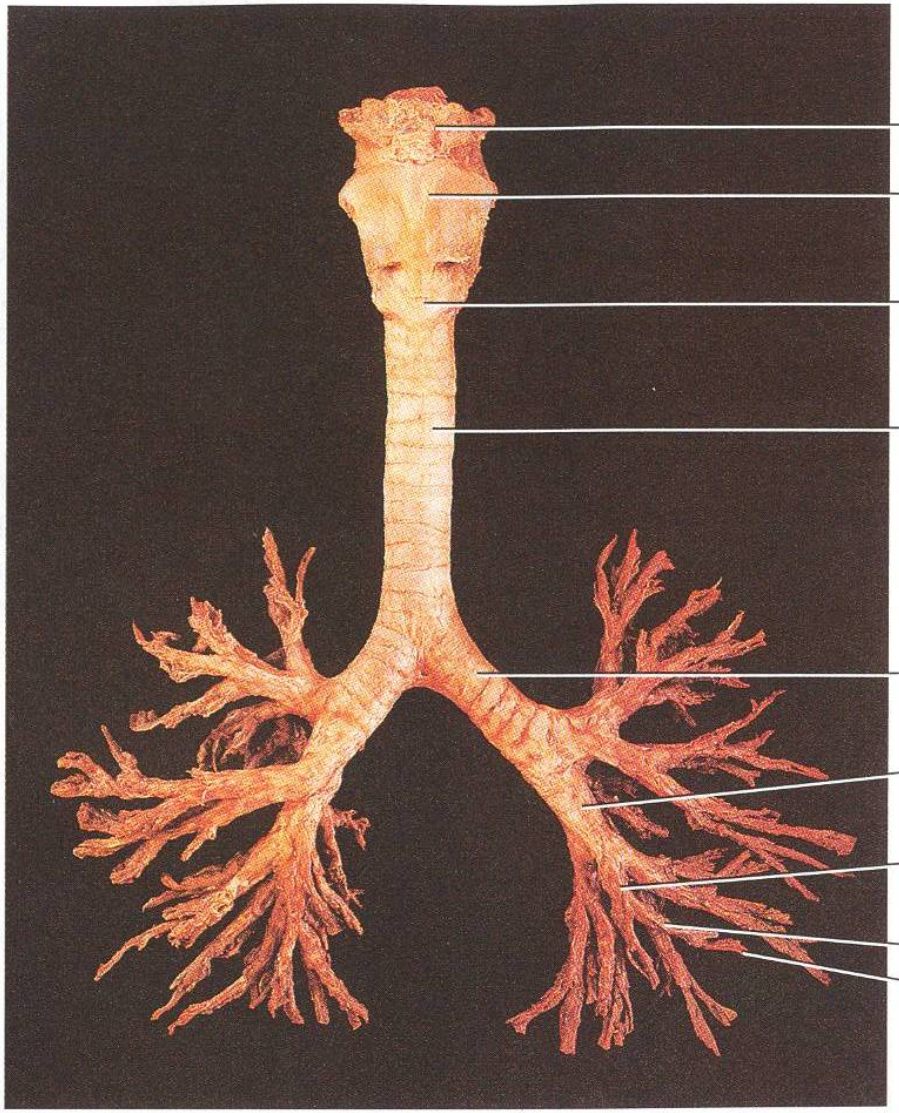
Left and Right primary (1°) Bronchi

- Right and left (1°) bronchi
  - Trachea branches within mediastinum
- Bronchial tree – extensively branching respiratory passageways
- (1°) bronchi – largest bronchi
- Right (1°) bronchi – wider and shorter than the left (foreign object more likely to lodge in right (1°) bronchi)

- Secondary (lobar) bronchi
  - Three on the right
  - Two on the left
- Tertiary (segmental) bronchi
  - Branch into each lung segment
- Bronchioles – little bronchi, less than 1 mm in diameter
- Terminal bronchioles – less than 0.5 mm in diameter

- Bronchopulmonary segments
  - 10 in right lung; 8-9 in left lung
  - Gives rise to 50-80 terminal bronchioles

SUPERIOR



INFERIOR

(b) Anterior view

How many lobes and secondary bronchi are present in each lung?

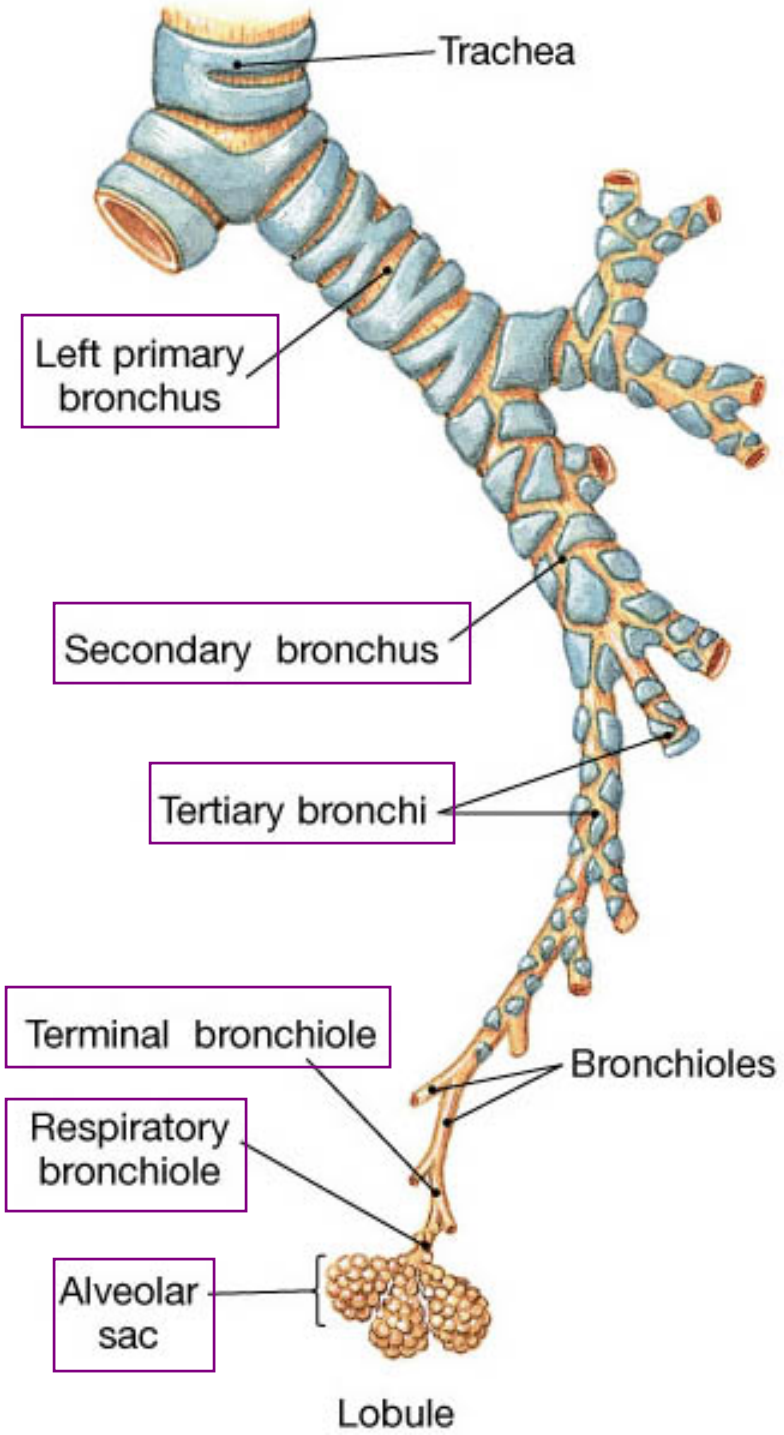
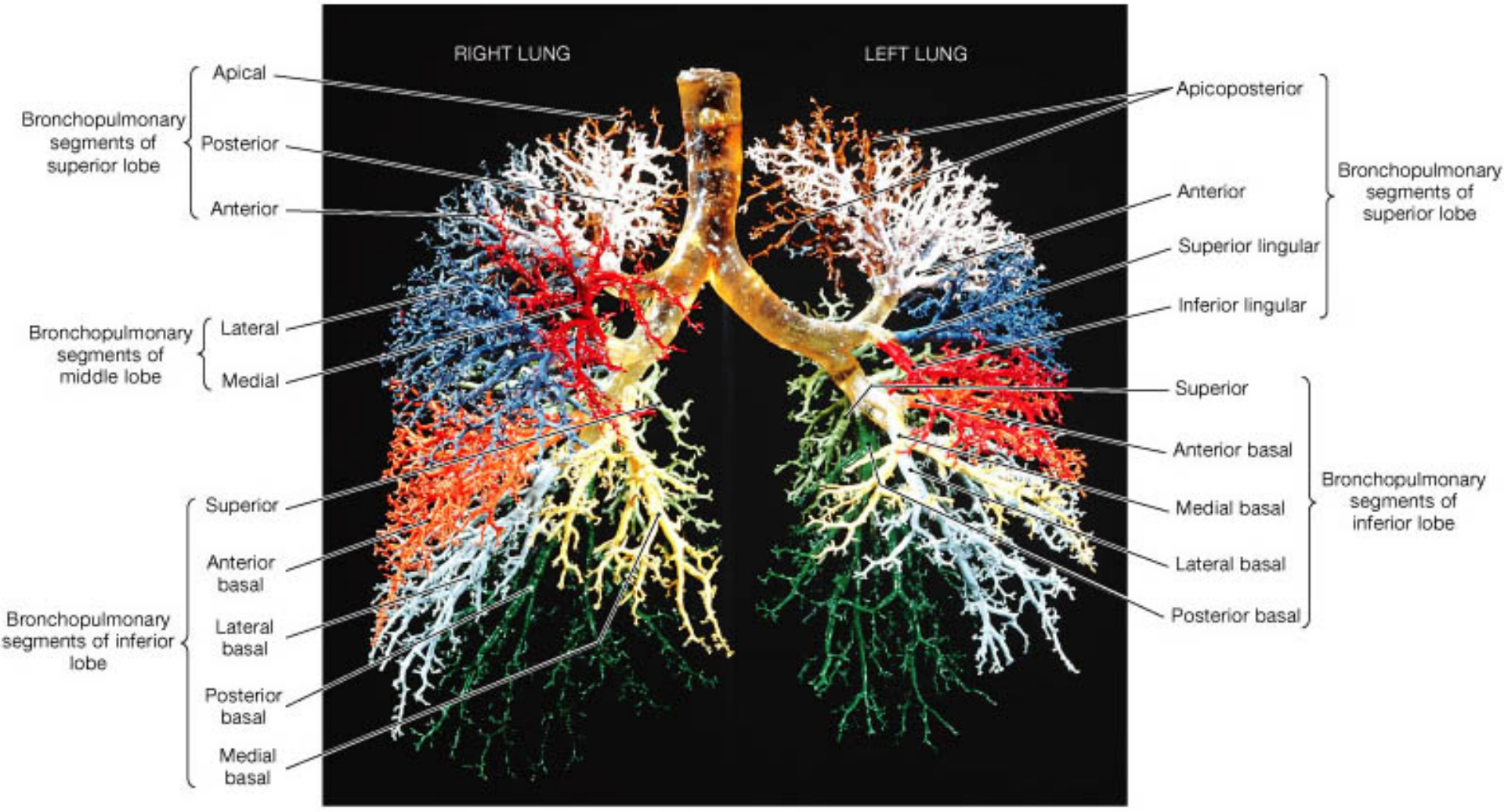

Trachea
Left primary bronchus
Secondary bronchus
Tertiary bronchi
Terminal bronchiole
Bronchioles
Respiratory bronchiole
Alveolar sac
Lobule

Fig 24.11



(d) The bronchial tree

Lungs

Held within Pleural Cavities

visceral / parietal pleura

Diaphragmatic surface- diaphragm forms floor

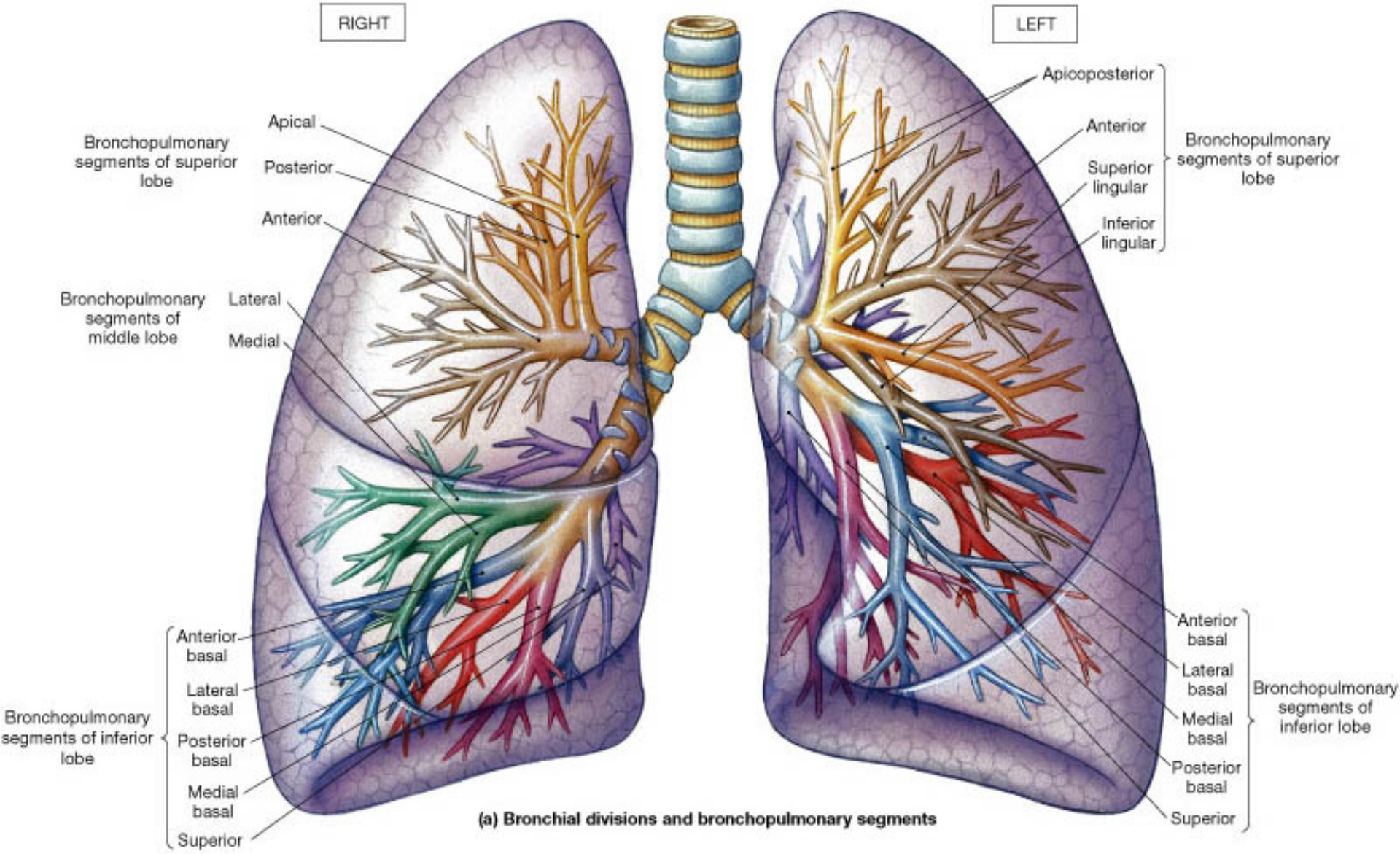
Costal surface- rib cage forms outer wall

Mediastinal Surface-medial surface

Right Lung= 3 lobes; Left lung= 2 lobes

Lungs

- Separated by fissures
  - Right lung has three lobes
  - Left lung has two lobes
- Costal surface
  - Anterior surface
  - Follows contours of rib cage
- Mediastinal surface
  - hilus-pulmonary vessels, (1^{o}) bronchi, nerves



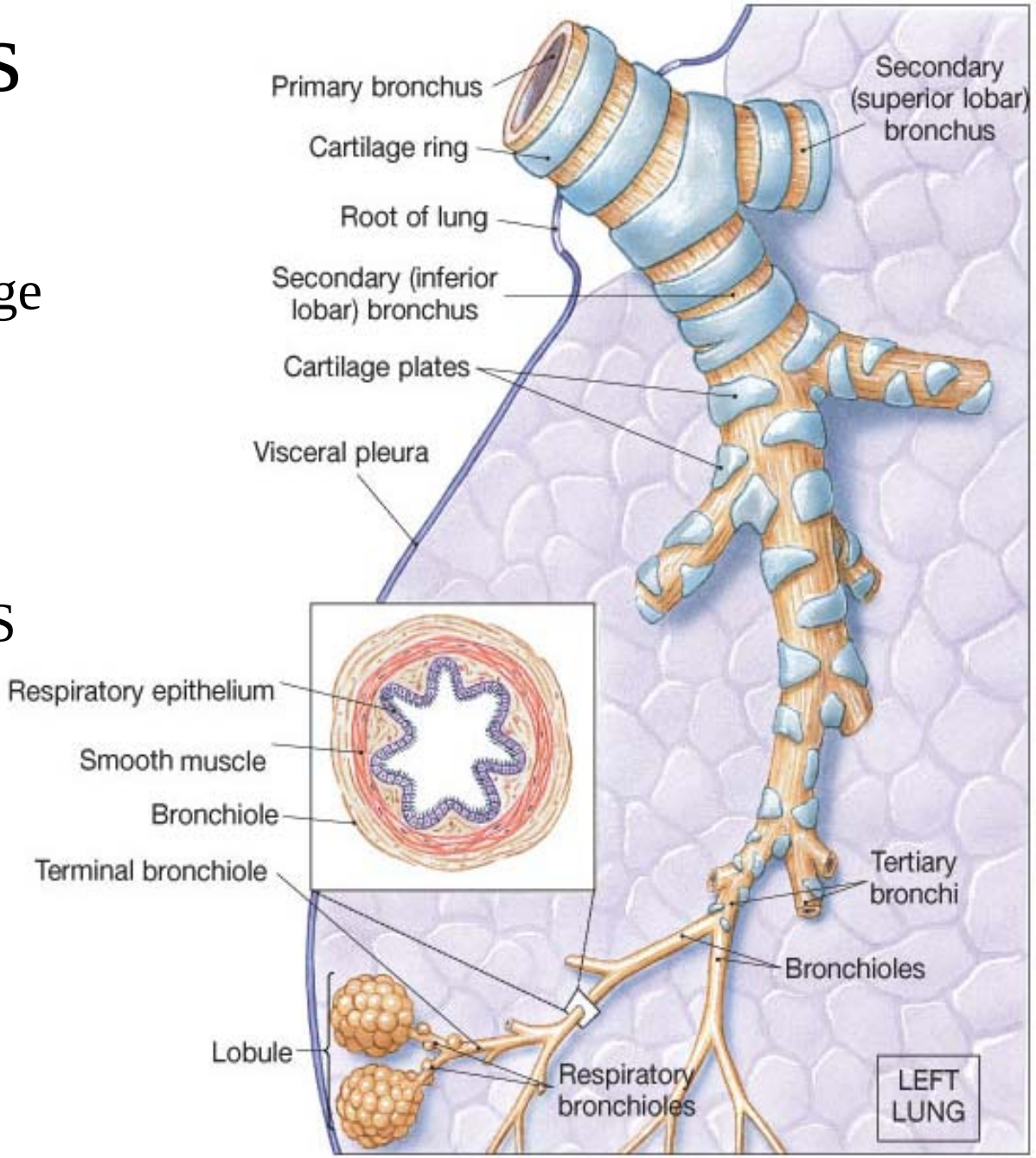
(a) Bronchial divisions and bronchopulmonary segments

Bronchioles

- Do not contain cartilage
- Have smooth muscle
- Are Innervated by ANS

Parasympathetic
– constrict airways

Sympathetic
– dilate airways



- Alveoli 150 million per lung
- Surrounded by capillaries & elastic fibers
- Capillaries cover 90% of surface
- Elastic fibers-for recoil to push air out (assists ventilation).
- Internal surfaces
    - A site for free movement of alveolar macrophages

Cells of alveoli

Alveolar type I cells – simple squamous epithelium

- more numerous
- makes ‘walls’ of alveoli
- provides surface area for gas exchange
- thin-good for diffusion

Alveolar type II/surfactant cells – release surfactant

- Produce surfactant to reduce surface tension
- Prevents alveolar collapse during exhalation
- Begin at 7-8 months of fetal development

Alveolar Macrophages –defense and protection of alveolar surface.

- **Respiratory Membrane** (blood-air Barrier)
- "point of gas exchange"
- Aveolar Epithelium simple squamous epithelia
- Fused basement membrane

Capillary endothelium simple squamous epithelia

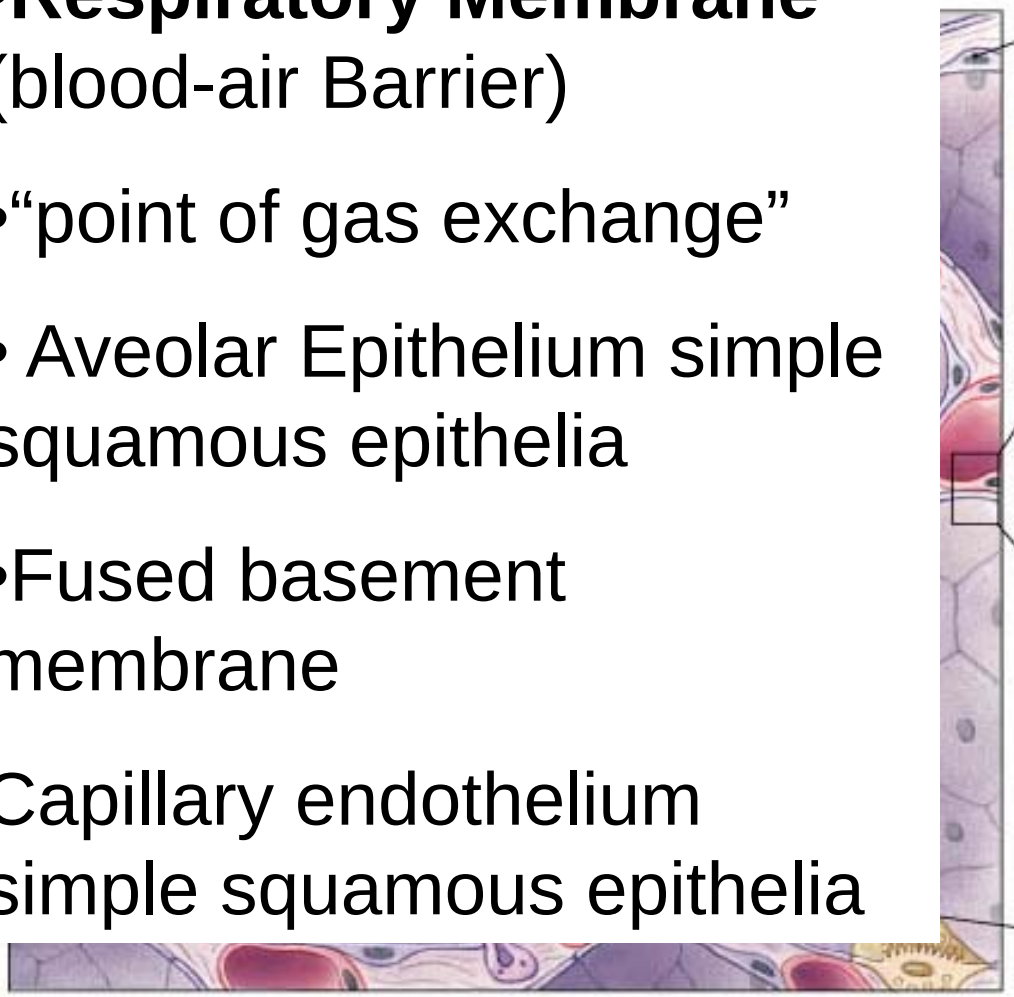
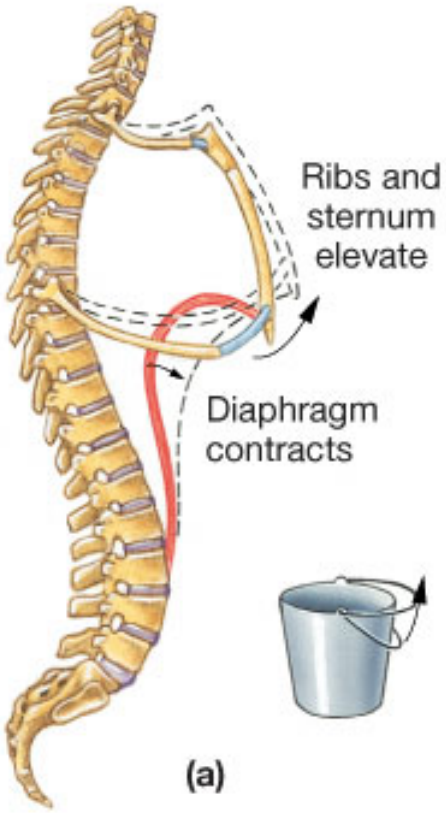
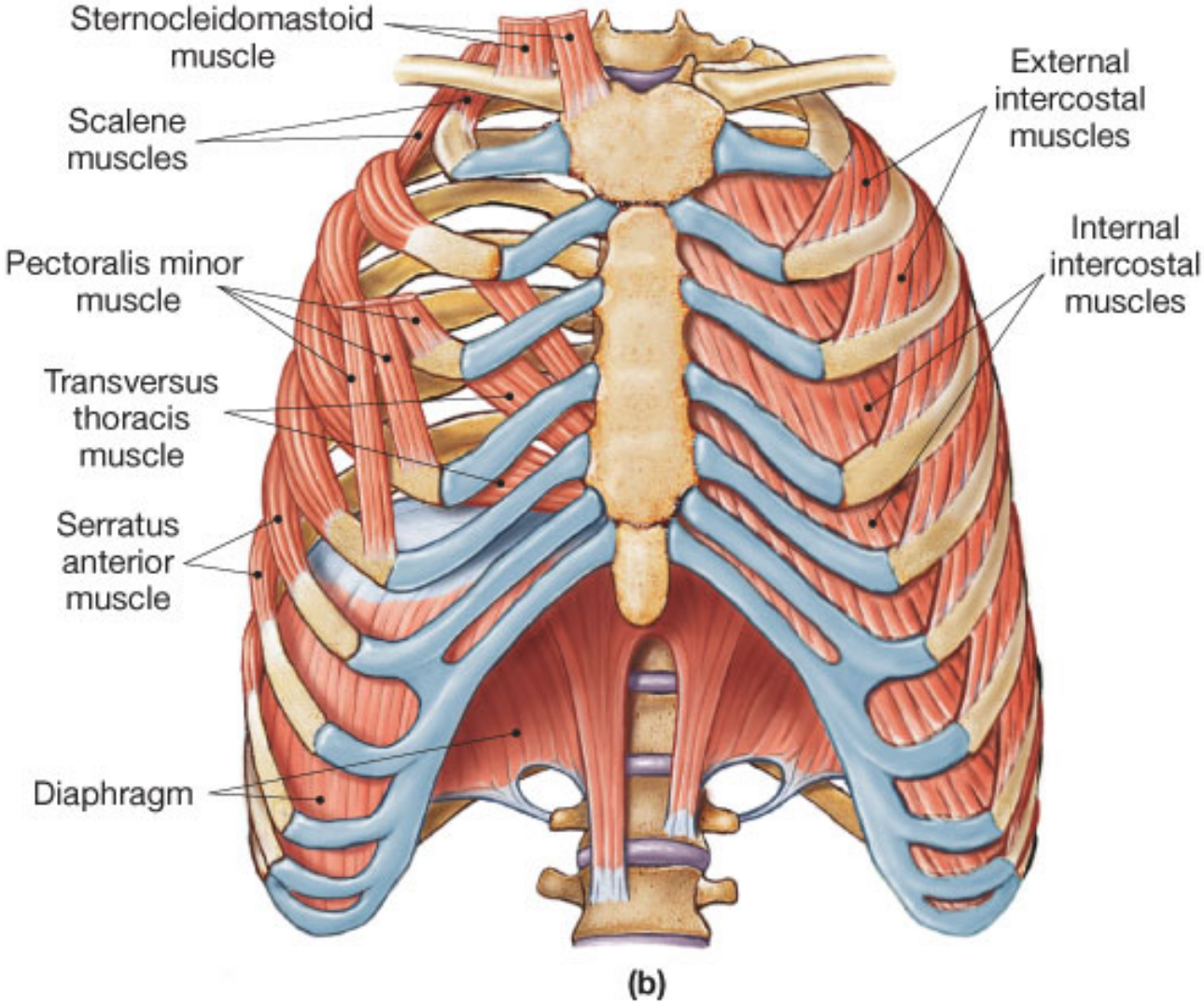


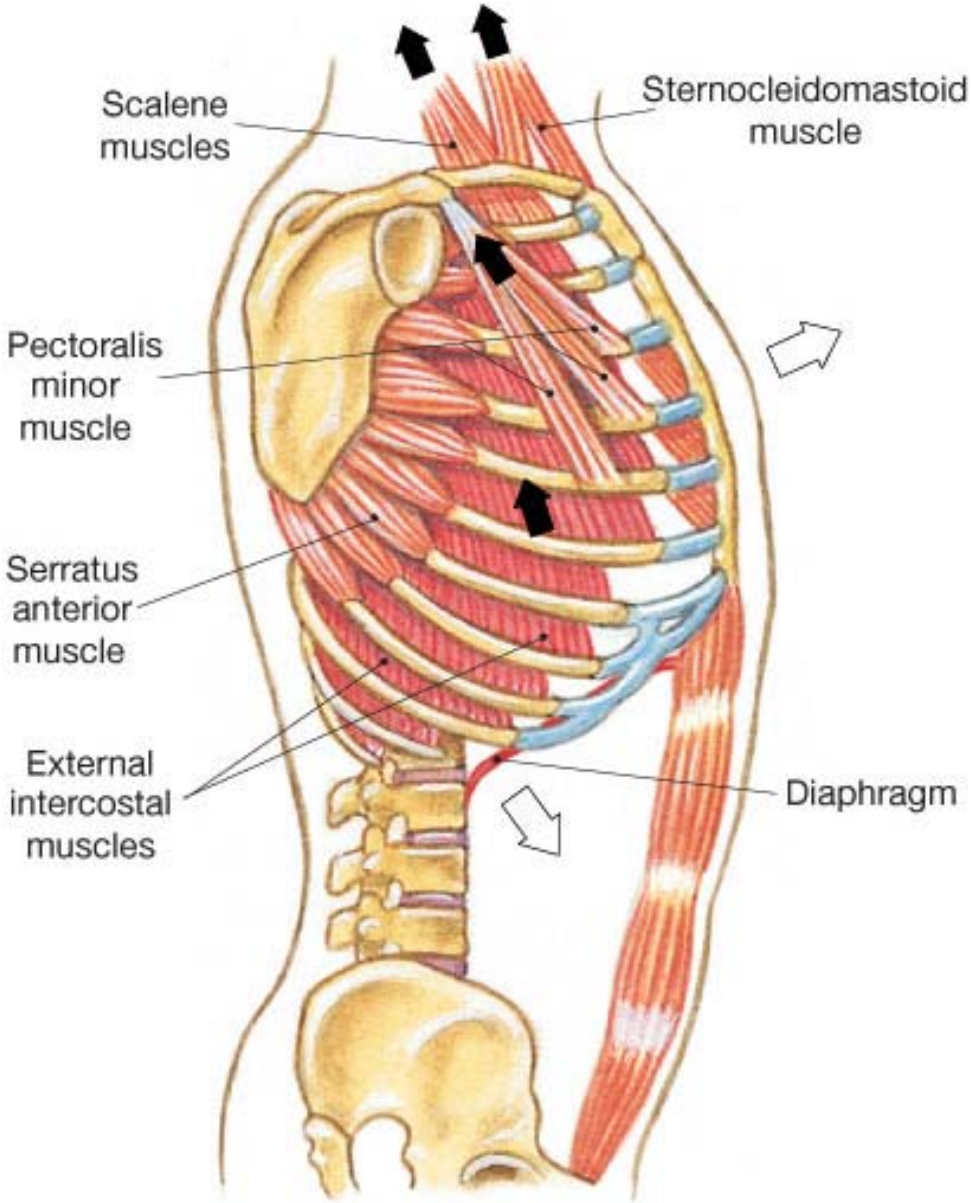
Fig 24.12

Respiratory Muscles





normal quite breathing at rest.



(c) Inhalation

Inspiration:

↑ volume of thoracic cavity.

Muscle activity required:

Diaphragm

External Intercostals

Sternocleidomastoid

To increase depth and frequency of breaths use:

Sternocleidomastiod

Scalenes

Expiration: ↓ volume of thoracic cavity.

No Muscular activity required

When Forcefully exhaling

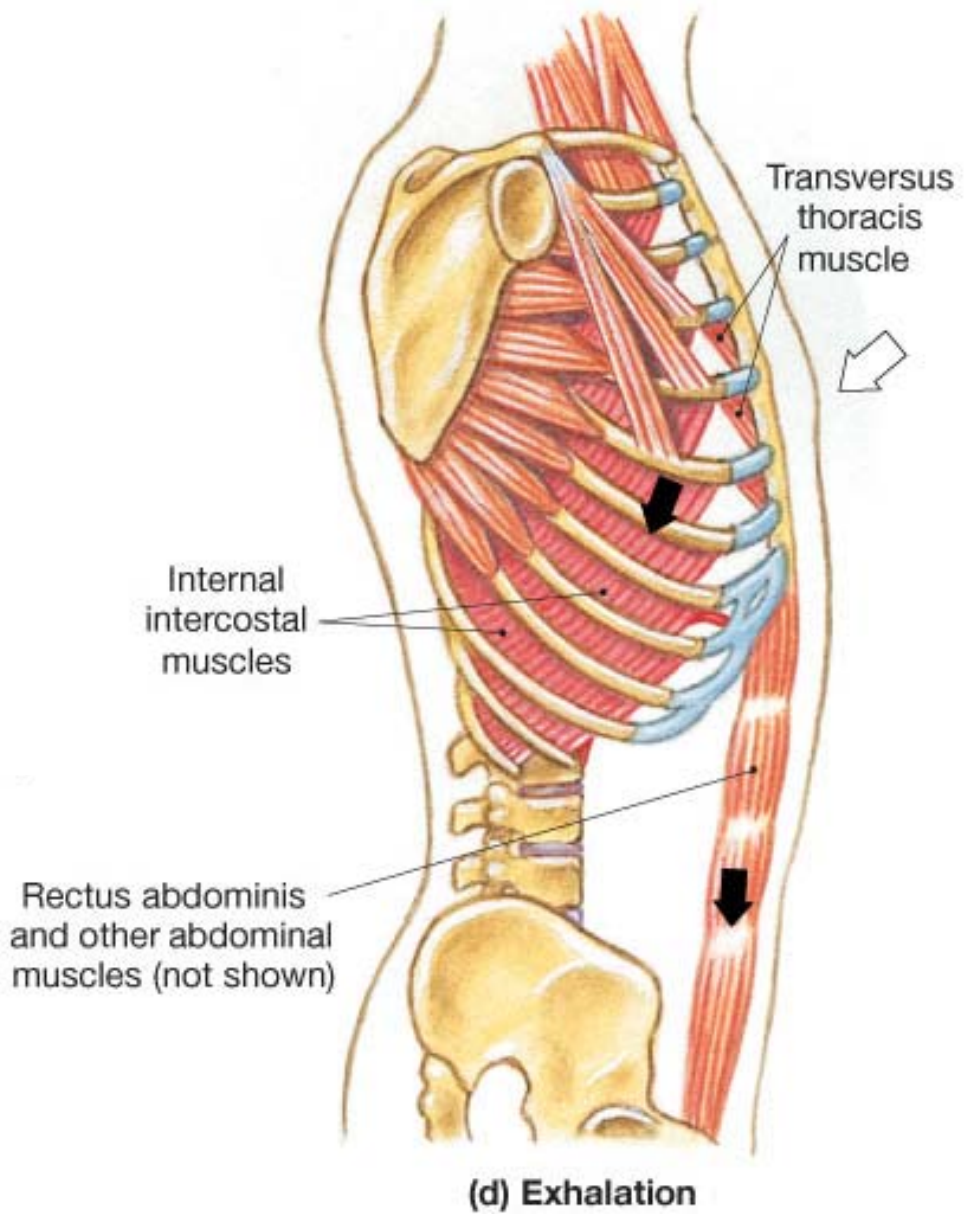
Muscles used:

Internal Intercostals

Rectus abdominis

Transverse abdominis,

Internal and External obliques.



Sensory Receptors - regulate respiration.

Mechanoreceptors

detect changes in lung volume or arterial blood pressure

Chemoreceptors

Changes in P_{CO2}, pH, P_{O2} of blood and CSF

Central chemoreceptors - in medulla

Peripheral chemoreceptors

Aortic bodies (in aorta)

Carotid bodies (in carotids)

CNS control

Respiratory rhythmicity center - Sets respiratory pace. in medulla oblongata.

Apneustic center - used for ‘overdrive’ when breathing deep.

Pneumotaxic center - sets limits to over inflation of lung.

- Bronchial asthma – an allergic inflammation

A hypersensitivity to irritants in the air or to stress

Asthma attacks characterized by: Contraction of bronchiole smooth muscle. Secretion of mucus in airways.

- Cystic fibrosis (CF) – inherited disease
  - Exocrine gland function is disrupted
  - Respiratory system affected by:
    - Oversecretion of viscous mucus

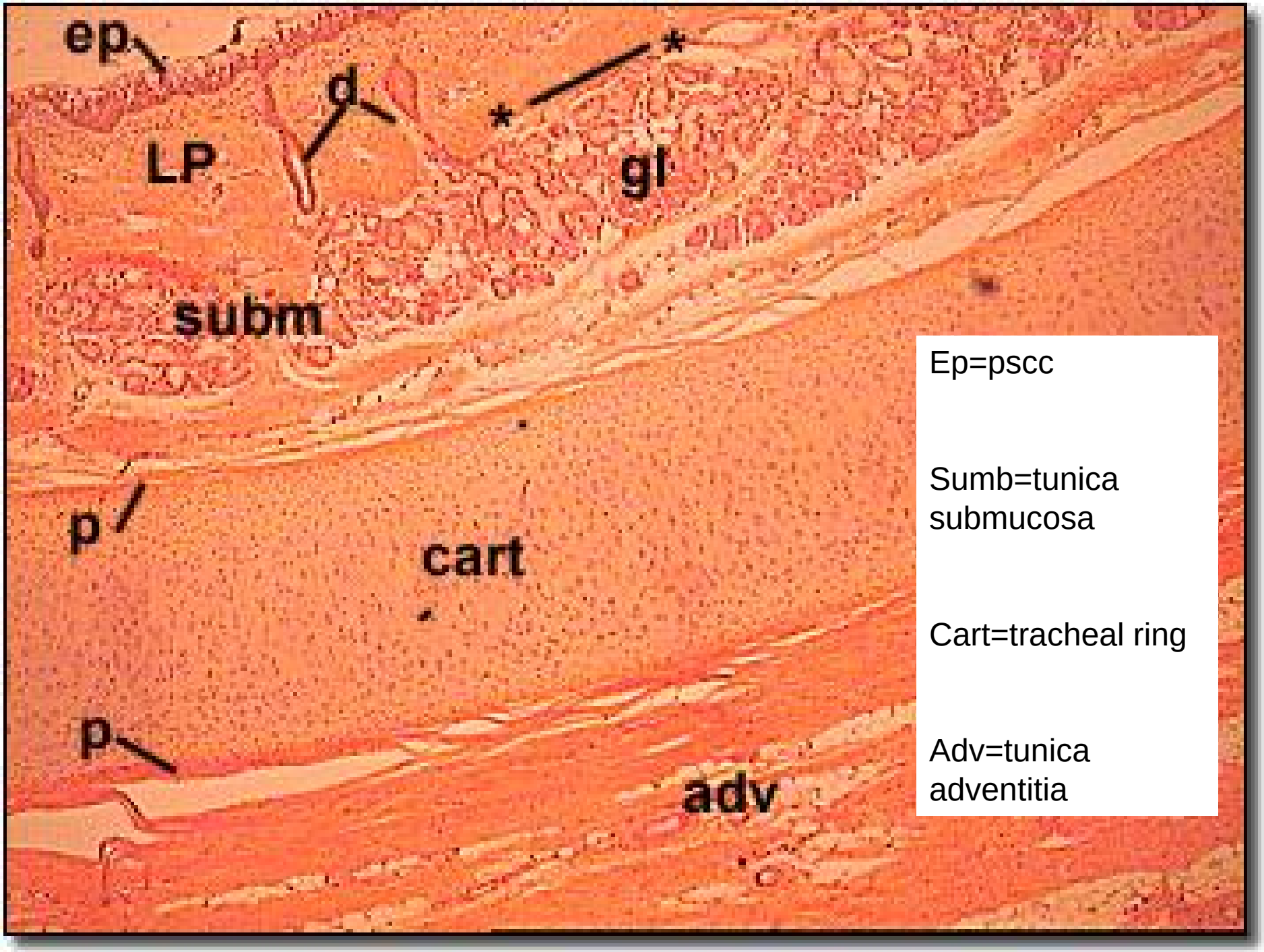
Smoking dries air, contaminates air and damages respiratory membrane nicotine, tar, carcinogens

Respiratory tracing

Air	**epithelial tissue**
External Nares	stratified squamous
Nasal cavity	pscc
Nasopharynx	pscc
Oropharynx	stratified squamous
Laryngopharynx	stratified squamous
Larynx	stratified squamous
Trachea	pscc
Rt./Lt. primary bronchi	pscc
Secondary (lobar) bronchi	pscc
Tertiary (segmental) bronchi	pscc
Terminal bronchioles	simple cubodial
Respiratory bronchioles	simple cubodial
Alveolar duct	simple squamous
Alveolar sac	simple squamous
Alveolus	simple squamous

Interactive CD

- Break
- Trachea slide


ep
d
*
*
LP
gl
subm
p
cart
p
adv
Ep=pscc
Sumb=tunica submucosa
Cart=tracheal ring
Adv=tunica adventitia

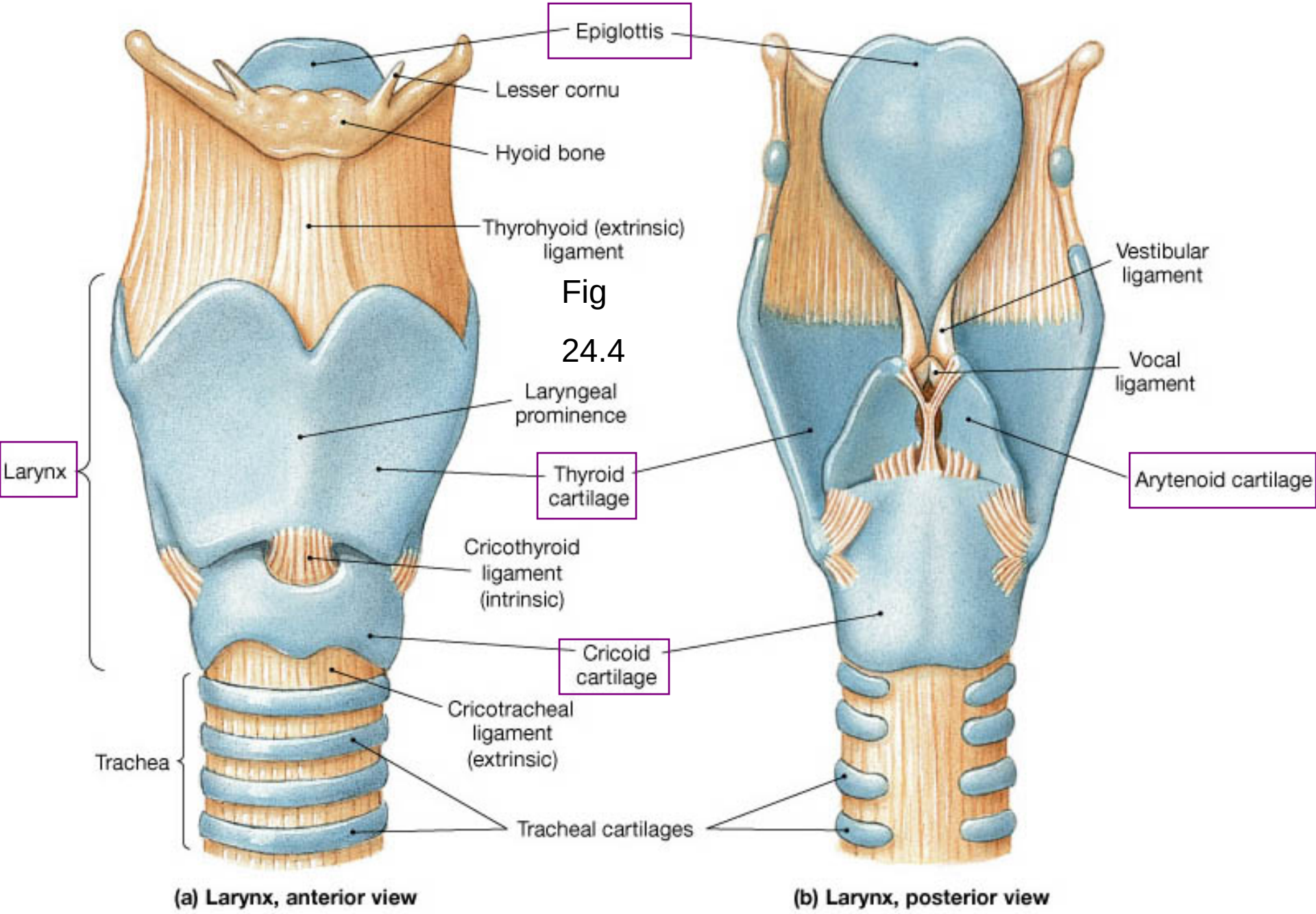
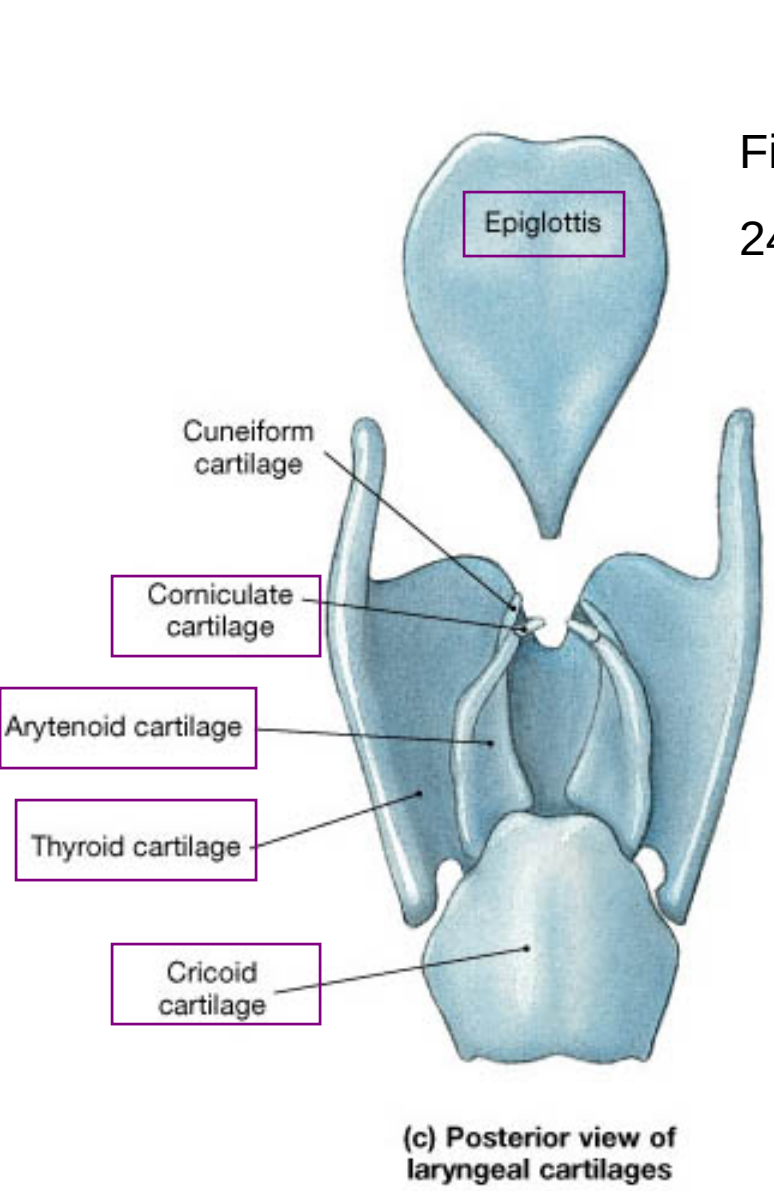
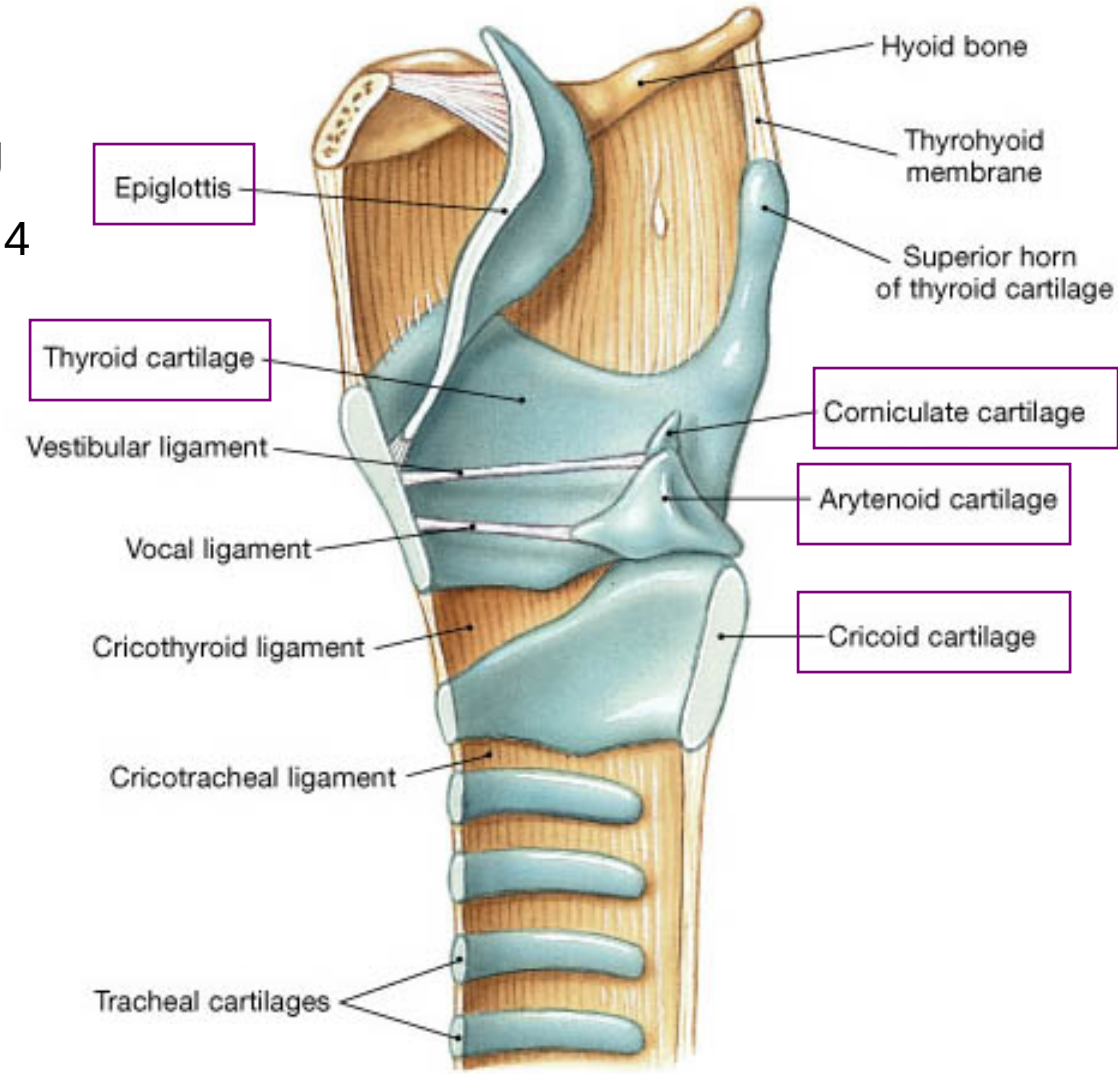

Epiglottis
Lesser cornu
Hyoid bone
Thyrohyoid (extrinsic) ligament
Laryngeal prominence
Larynx
Thyroid cartilage
Cricothyroid ligament (intrinsic)
Cricoid cartilage
Cricotracheal ligament (extrinsic)
Trachea
Tracheal cartilages
Vestibular ligament
Vocal ligament
Arytenoid cartilage
(a) Larynx, anterior view
(b) Larynx, posterior view

Fig 24.4

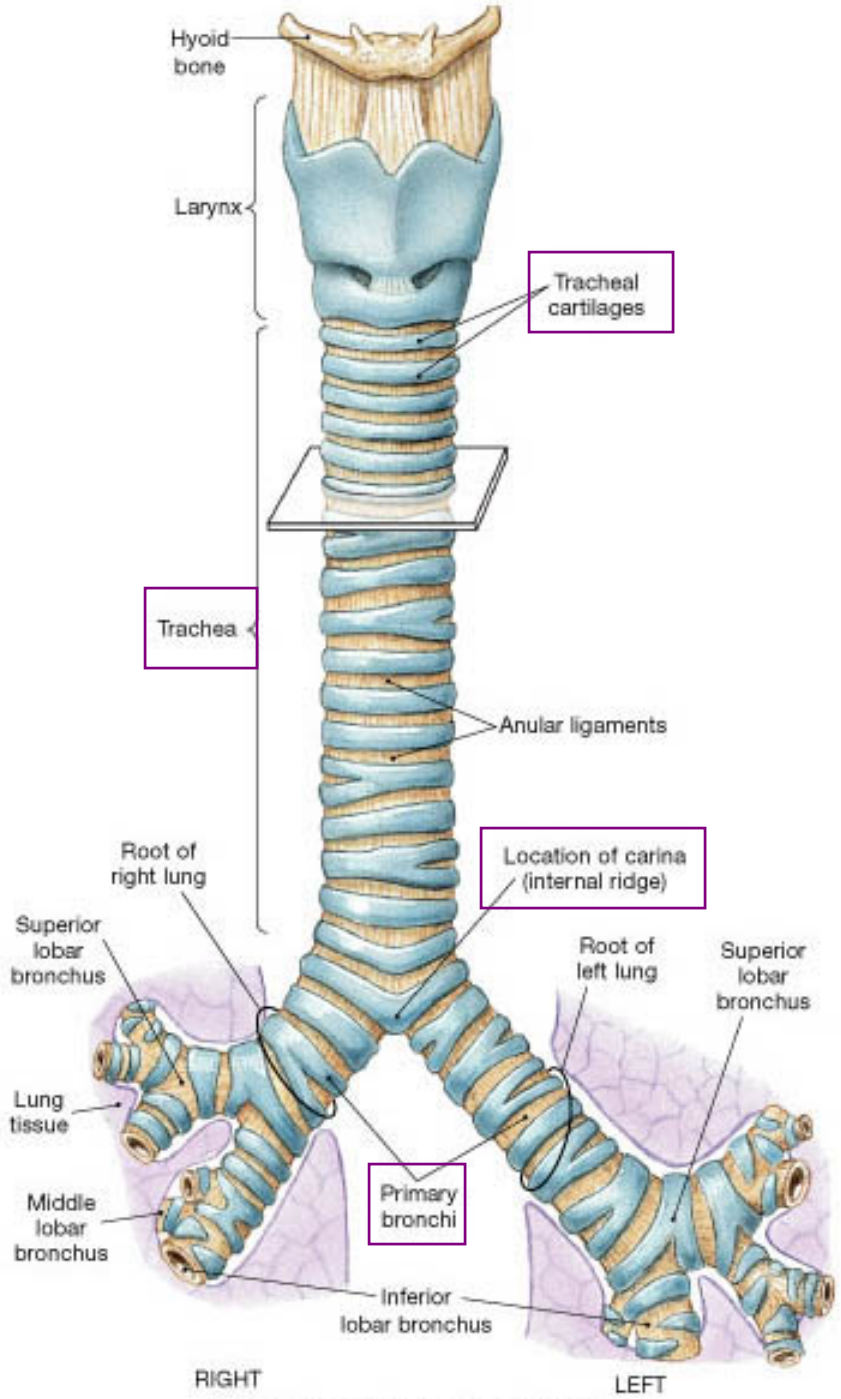
Fig 24.4



(c) Posterior view of laryngeal cartilages

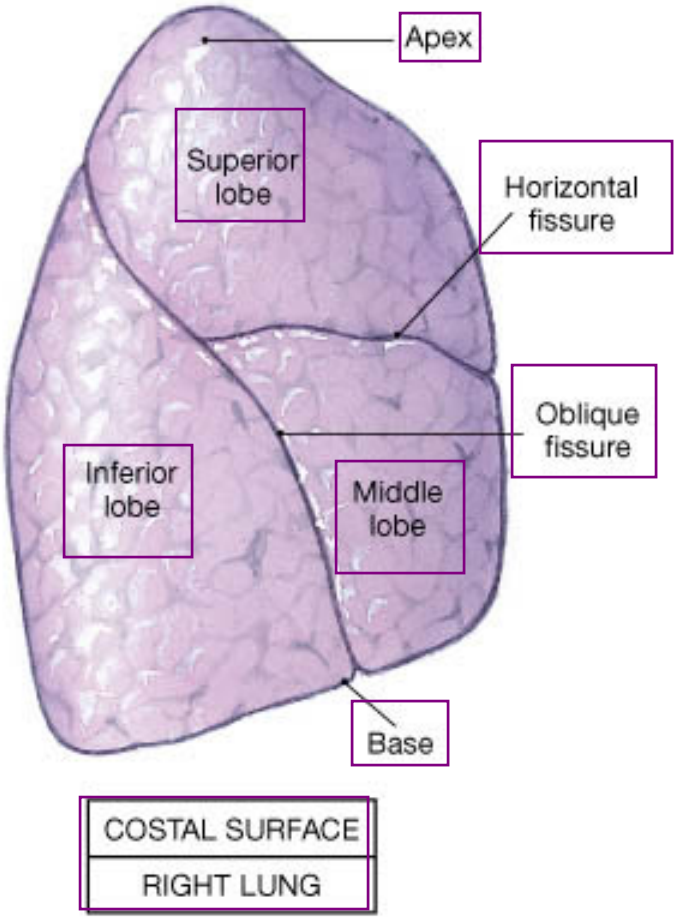


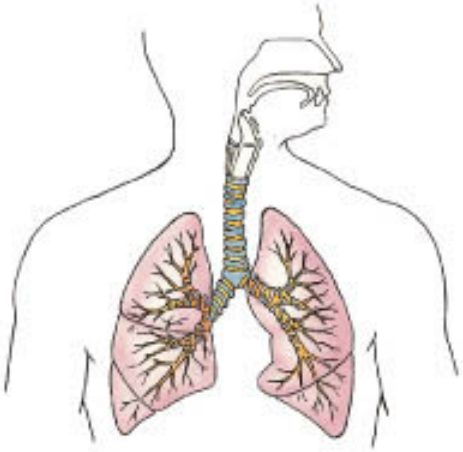
(d) Larynx, sagittal section



(a) Trachea and bronchi, anterior view

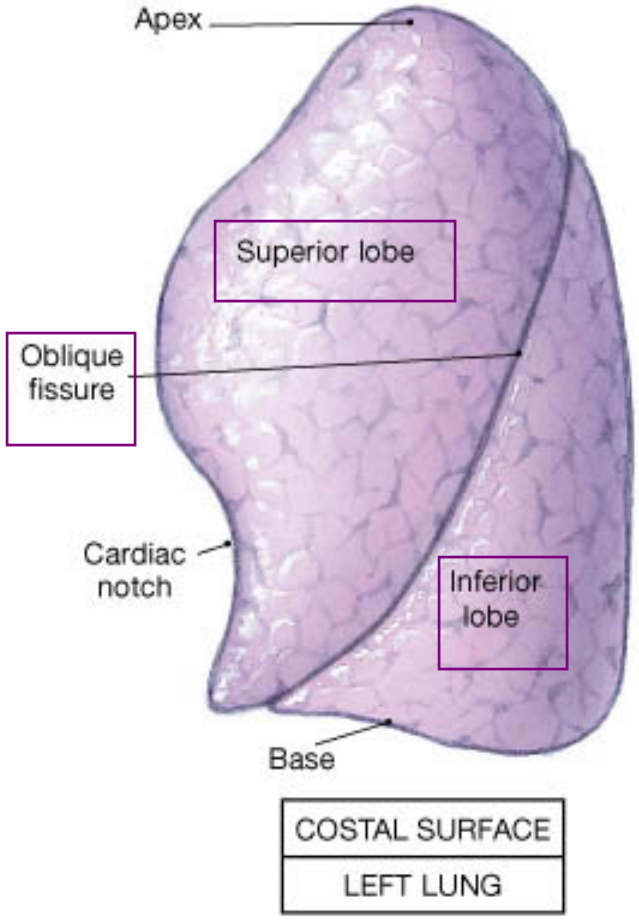
Fig 24.7

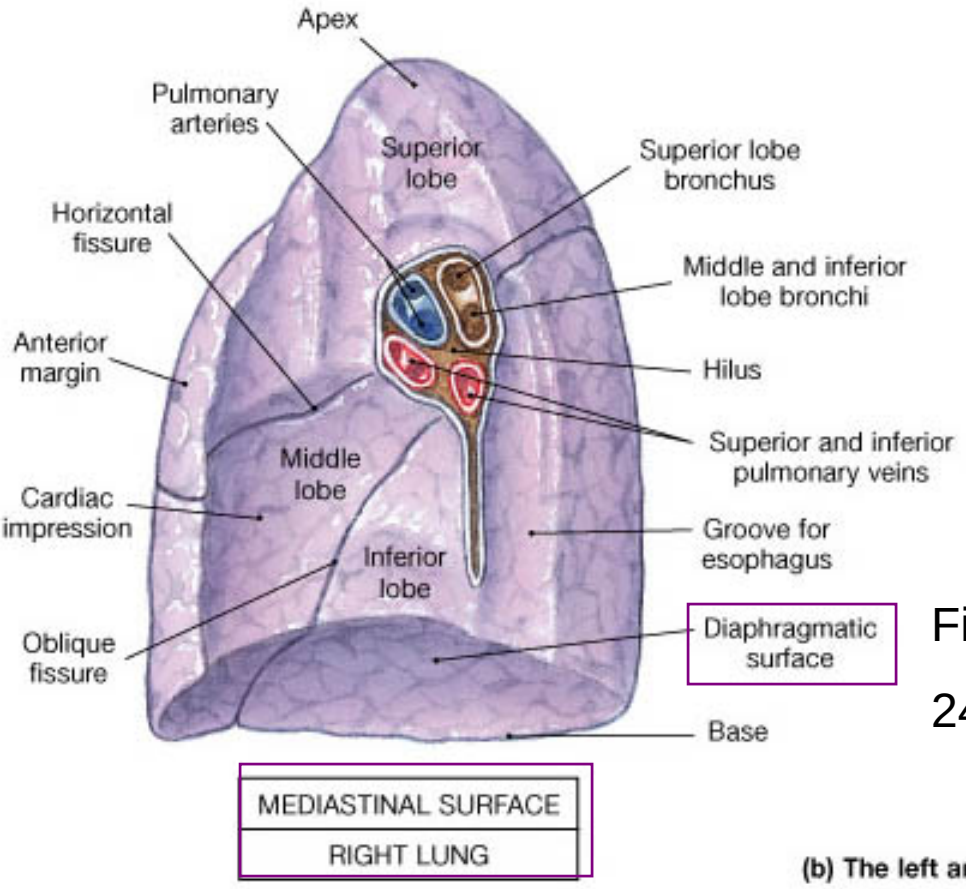

Apex
Superior lobe
Horizontal fissure
Oblique fissure
Inferior lobe
Middle lobe
Base
COSTAL SURFACE
RIGHT LUNG



Fig

24.8


Apex
Superior lobe
Oblique fissure
Cardiac notch
Inferior lobe
Base
COSTAL SURFACE
LEFT LUNG



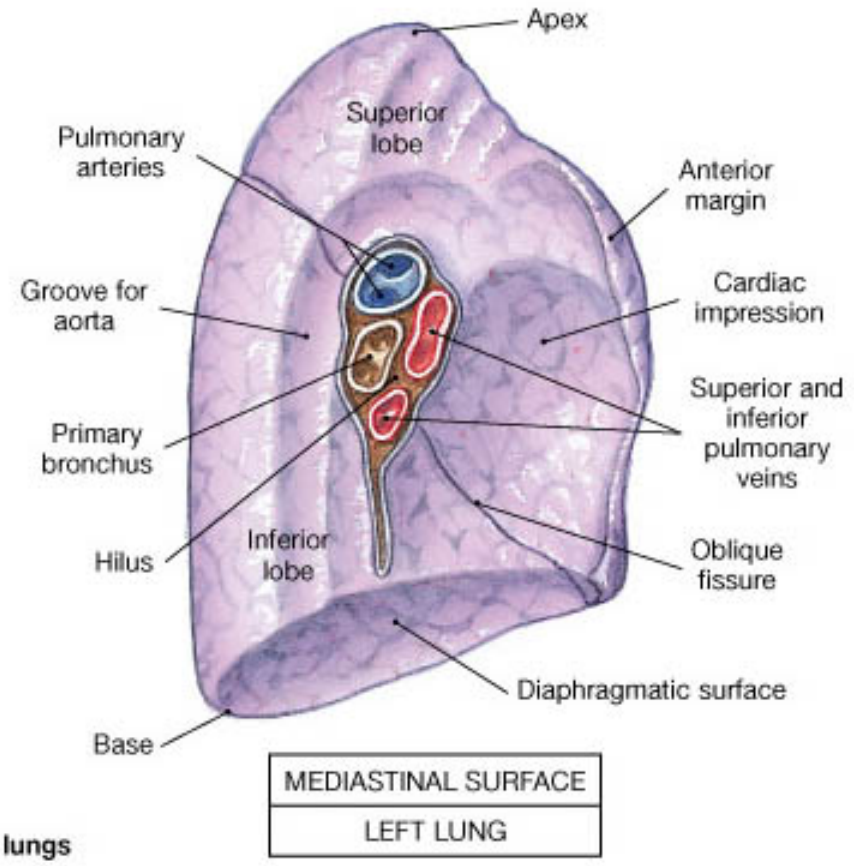
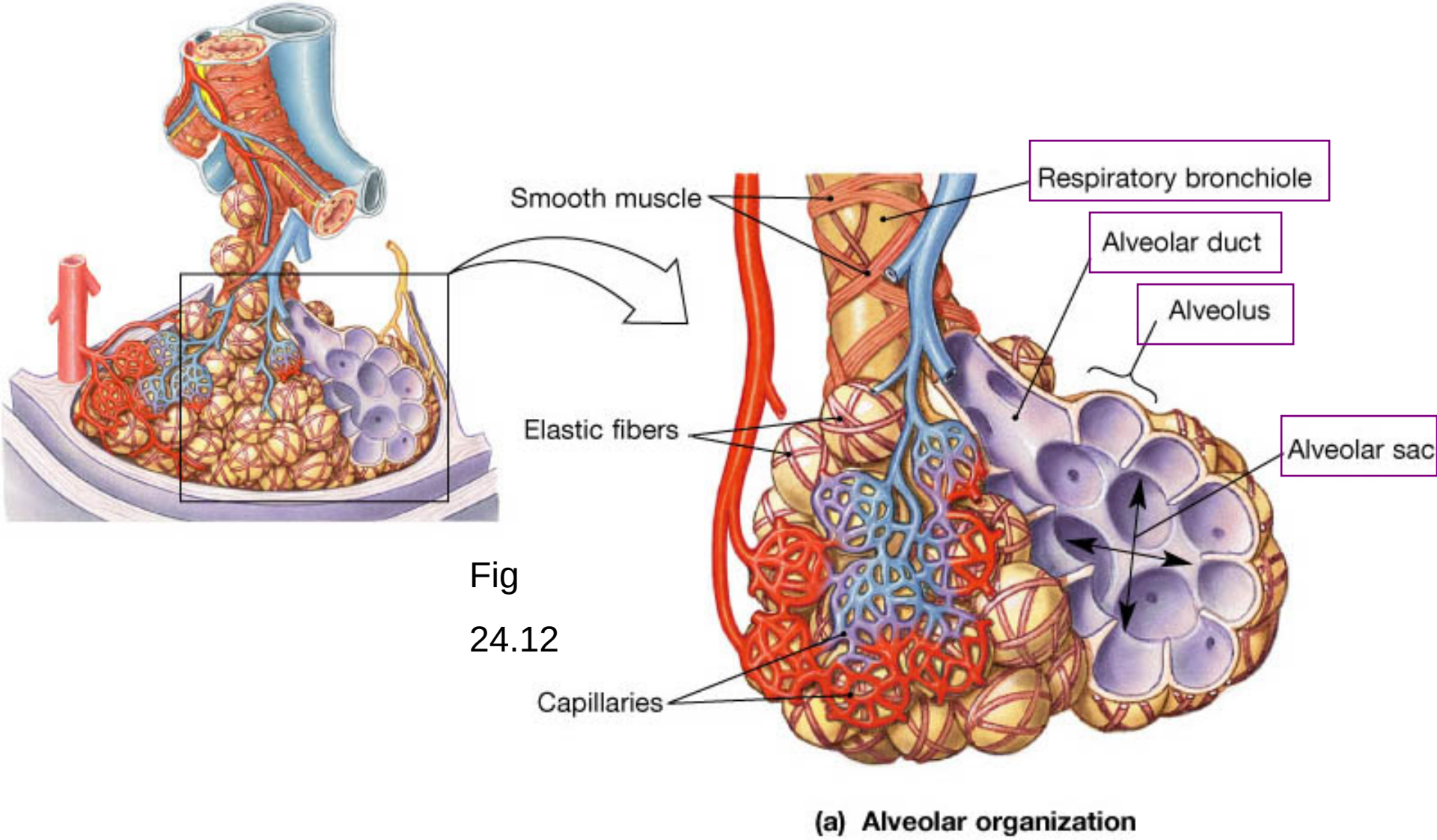


Fig 24.8

(b) The left and right lungs


Smooth muscle
Respiratory bronchiole
Alveolar duct
Alveolus
Elastic fibers
Alveolar sac
Capillaries
(a) Alveolar organization

Fig

24.12