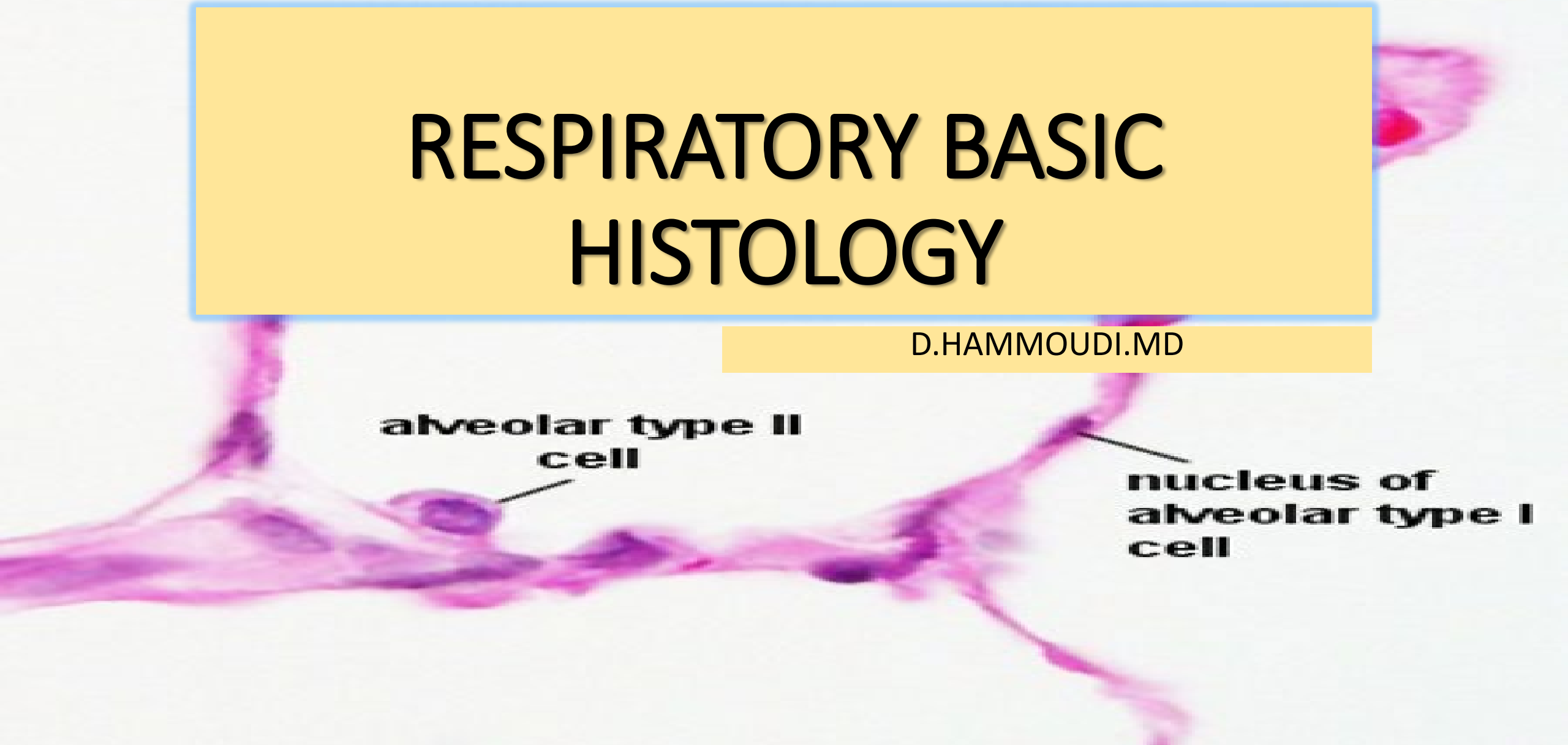


RESPIRATORY BASIC HISTOLOGY

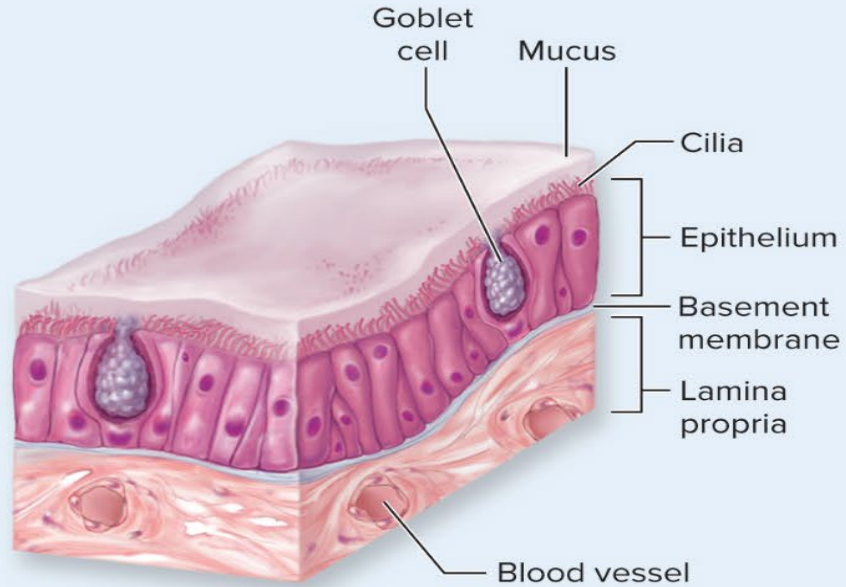
D.HAMMOUDI.MD

**alveolar type II
cell**

**nucleus of
alveolar type I
cell**



General structure of the respiratory mucosa



The mucosa is composed of an epithelium resting on a basement membrane and an underlying lamina propria composed of areolar connective tissue. The epithelium becomes progressively thinner from the nasal cavity to the alveoli with some exceptions.

(a)

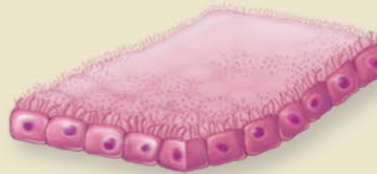
Progressively thinner epithelium



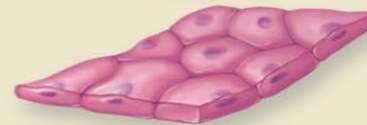
Pseudostratified ciliated columnar epithelium lines the nasal cavity, paranasal sinuses, nasopharynx, trachea, inferior portion of larynx, main bronchi, and lobar bronchi.



Simple ciliated columnar epithelium lines the segmental bronchi, smaller bronchi, and large bronchioles.



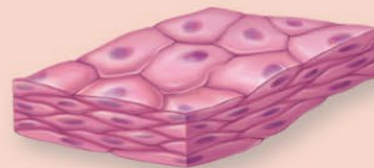
Simple ciliated cuboidal epithelium lines the terminal and respiratory bronchioles (a progressive loss of cilia is observed).



Simple squamous epithelium forms both the alveolar ducts and alveoli.

(b)

Exceptions

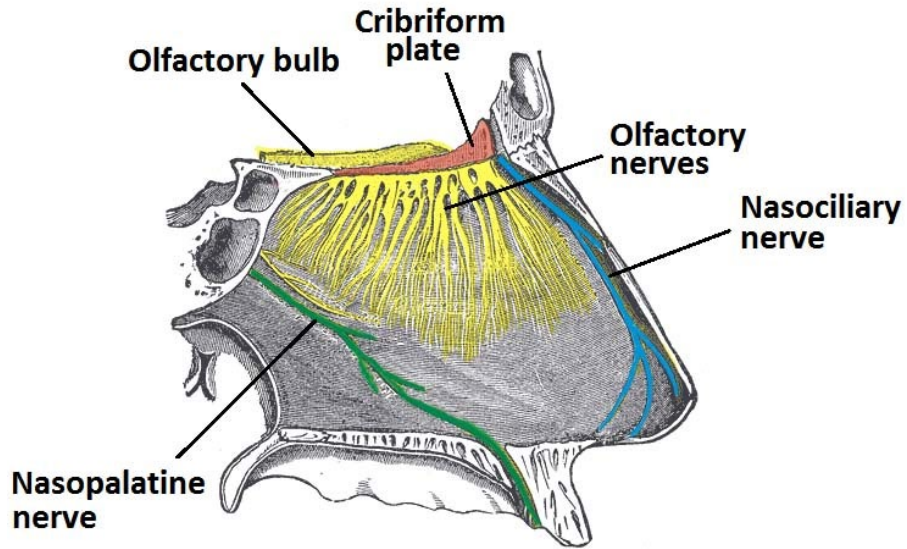


Nonkeratinized stratified squamous epithelium lines regions of the respiratory tract subject to abrasion, including the oropharynx, laryngopharynx, the vocal cords and the superior portion of the larynx.

(c)

NOSE

- Deeper in the nasal vestibule, stratified squamous epithelium becomes non-keratinized.
- Further down to the respiratory area it becomes Pseudostratified ciliated columnar epithelium with mucous goblet cells and Basal cells.



© teachmeanatomy
The #1 Appointed Human Anatomy Site on the Web

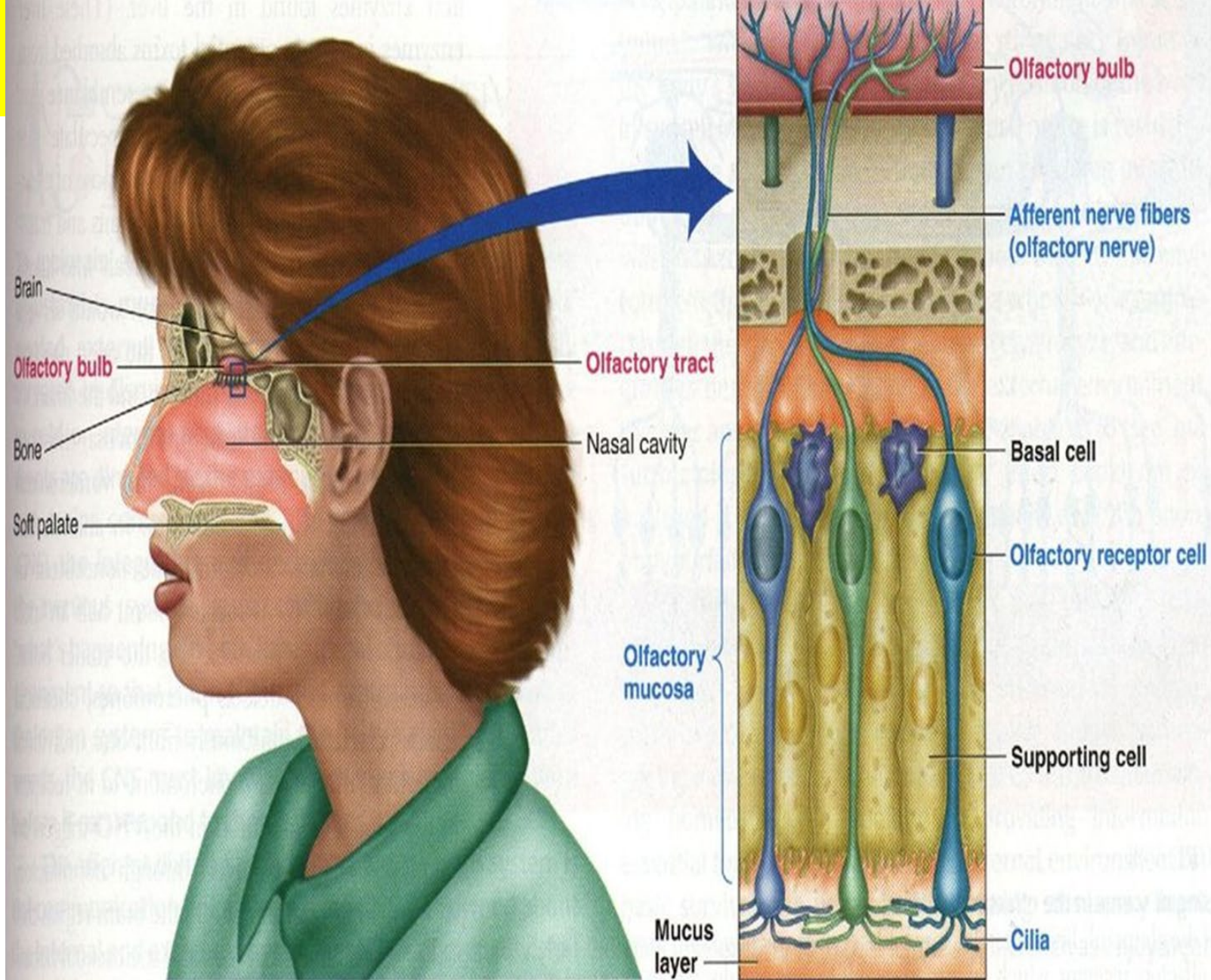
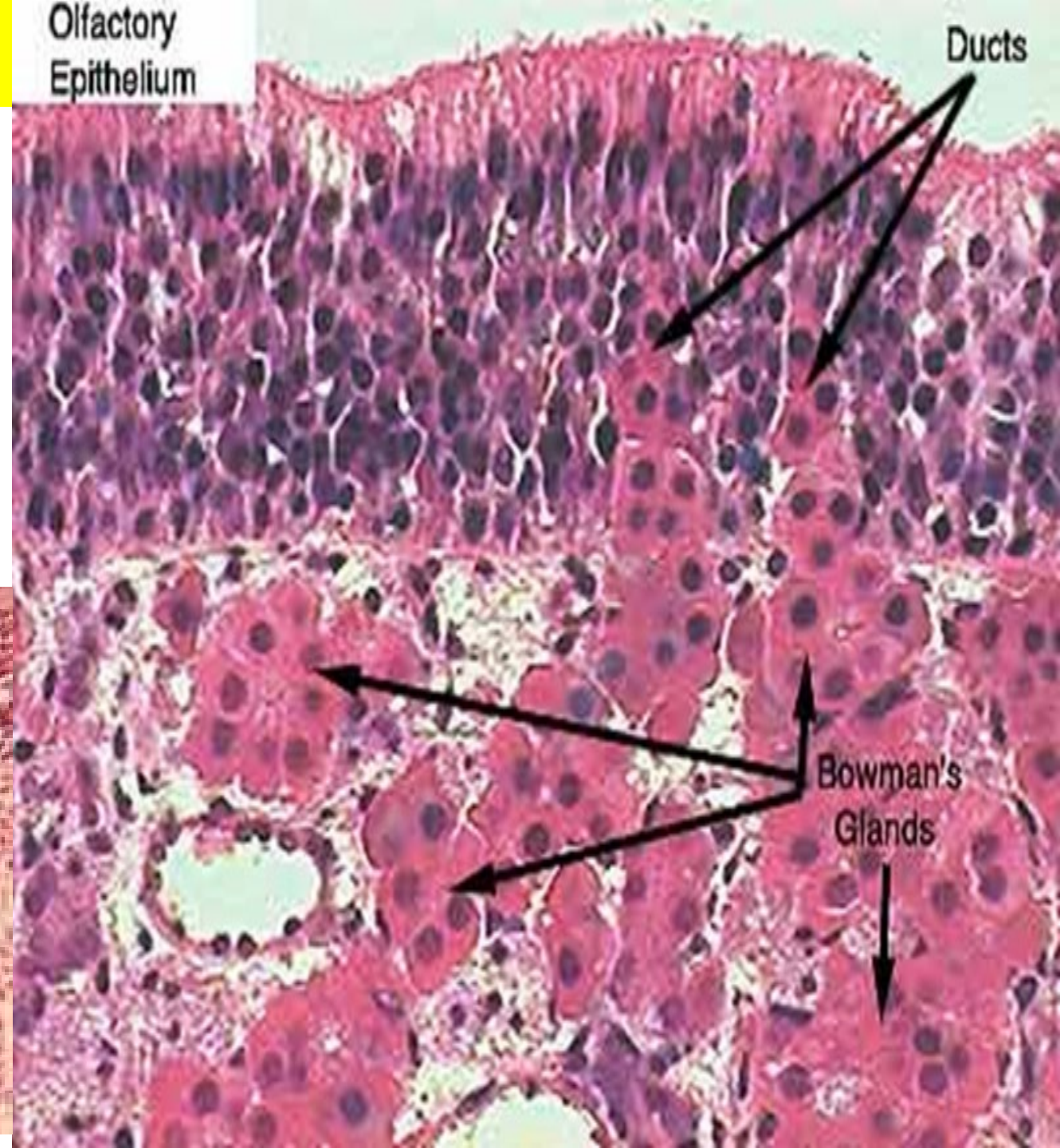


FIGURE 6-47

Location and structure of the olfactory receptors

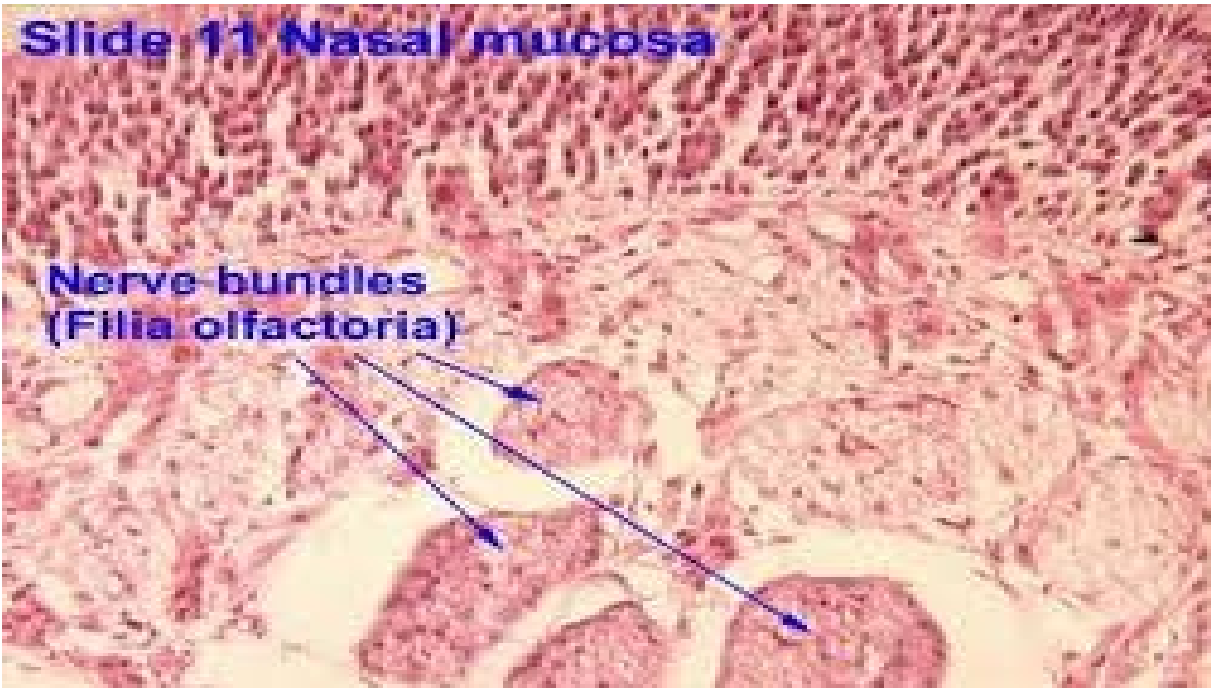
Olfactory or Sensory cells....

- The basal part of each sensory cell tapers into a slender cylindrical process that passes into the underlying lamina propria as axon which are collected into small **bundles "Fila Olfactoria" => cribriform plate**
- **Glands of Bowman** = Its watery secretions is carried to the surface of the narrow ducts to moisten the surface of the epithelium and serves as solvent for odiferous substances.
 - Its continous secretions freshens the surface film of fluid and prevents repetition of stimulation of the olfactory hairs of a single odor.

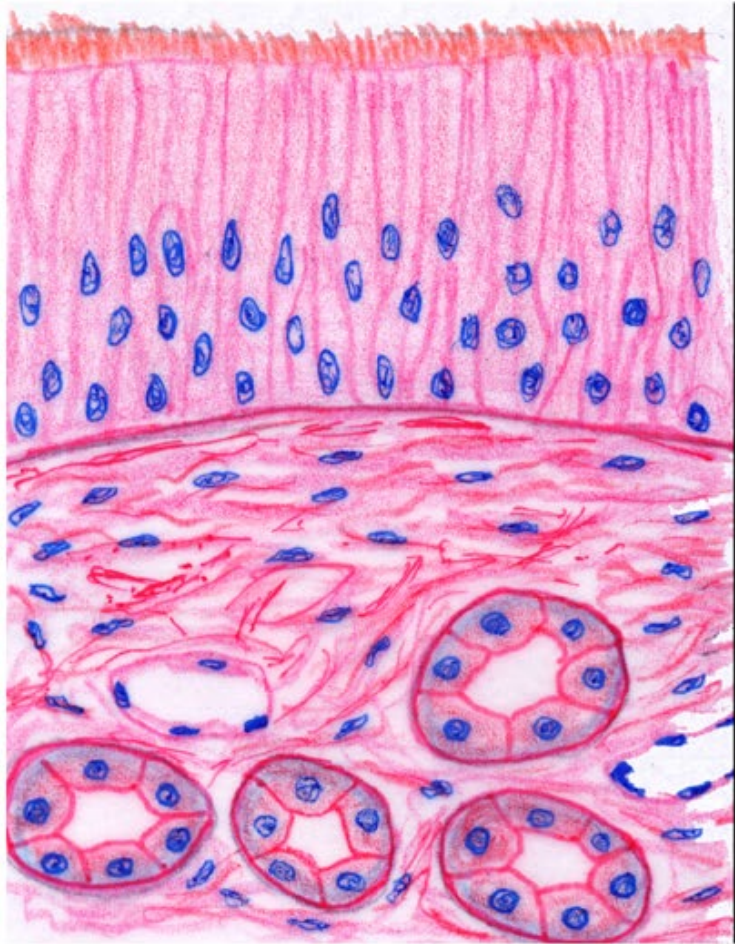


Slide 11 Nasal mucopsa

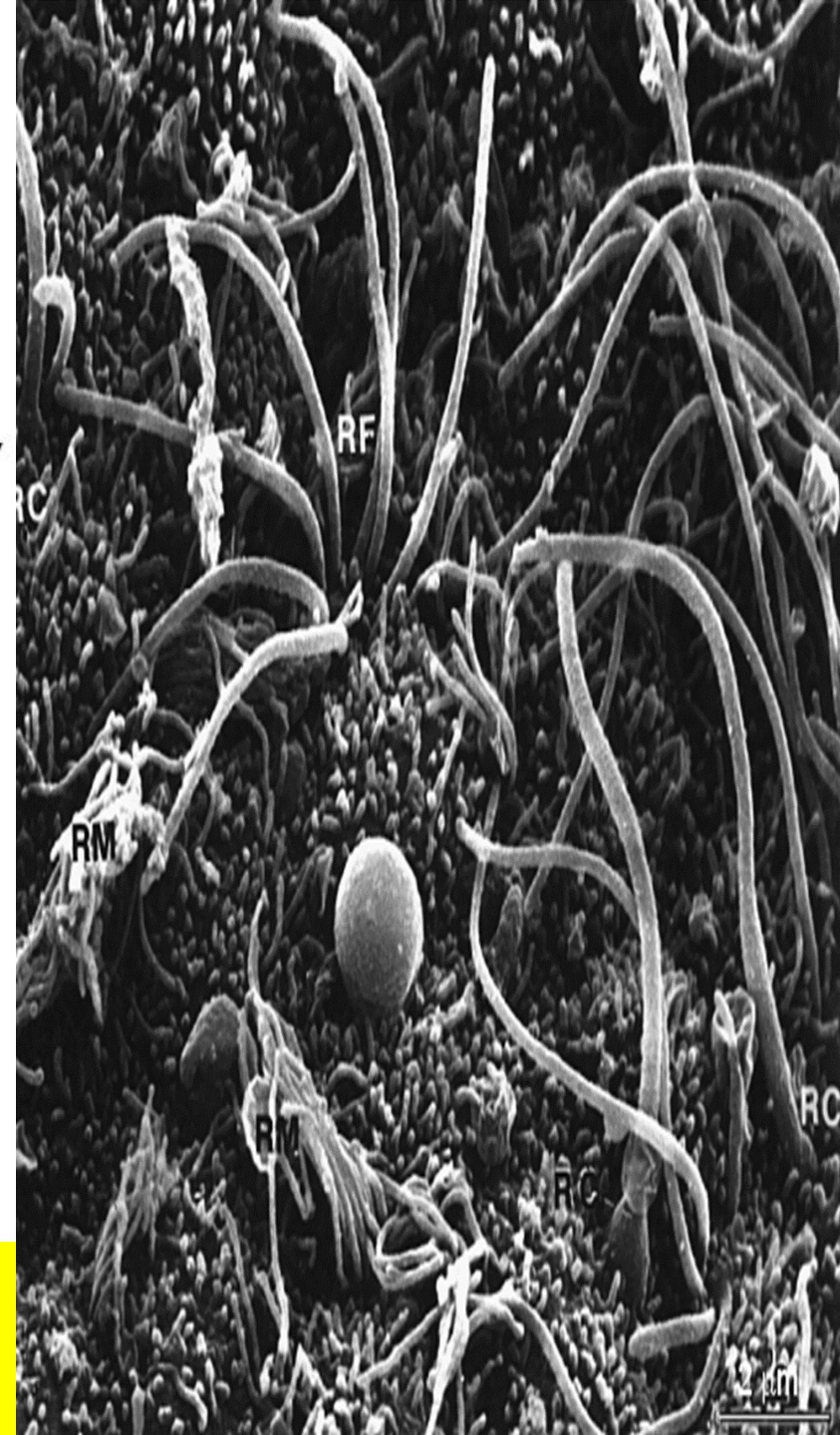
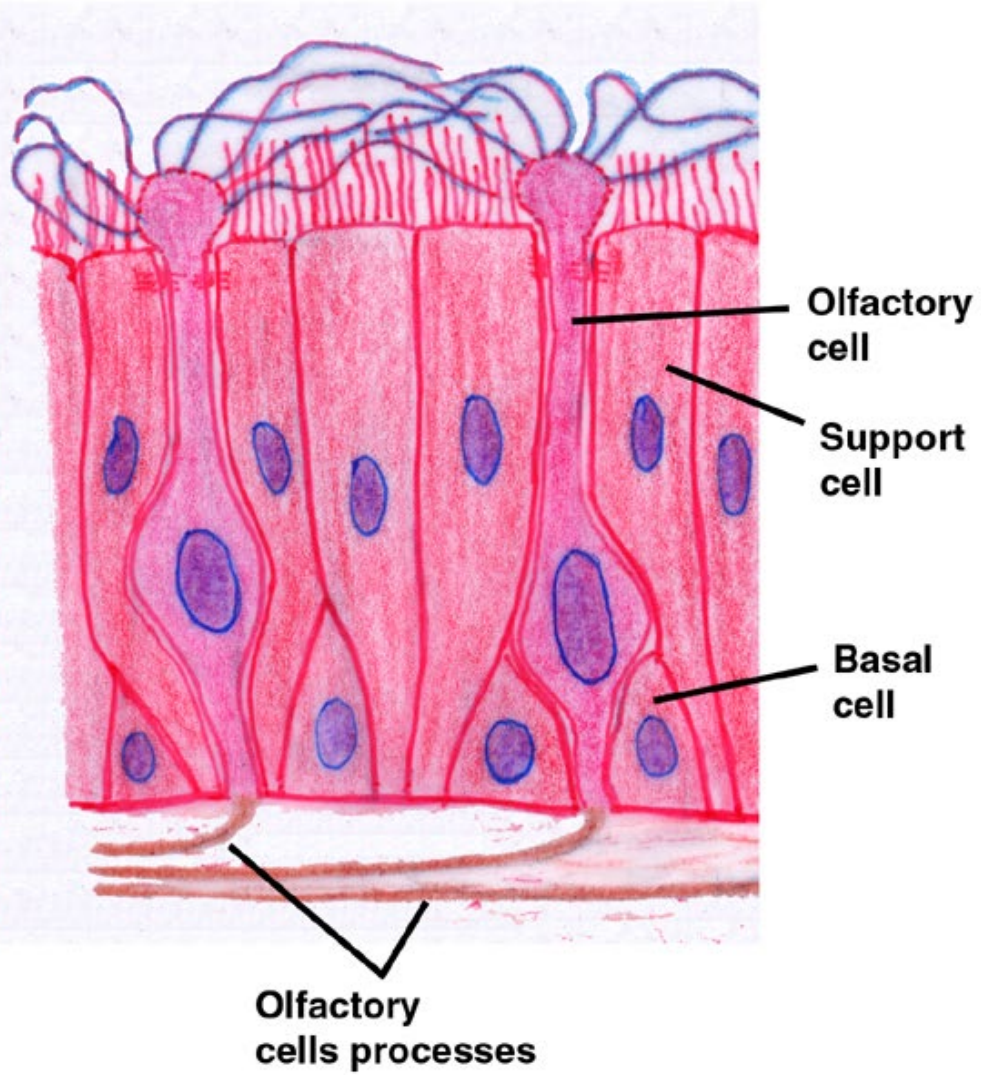
Nerve bundles
(Filia olfactoria)



RESPIRATORY



OLFACTORY



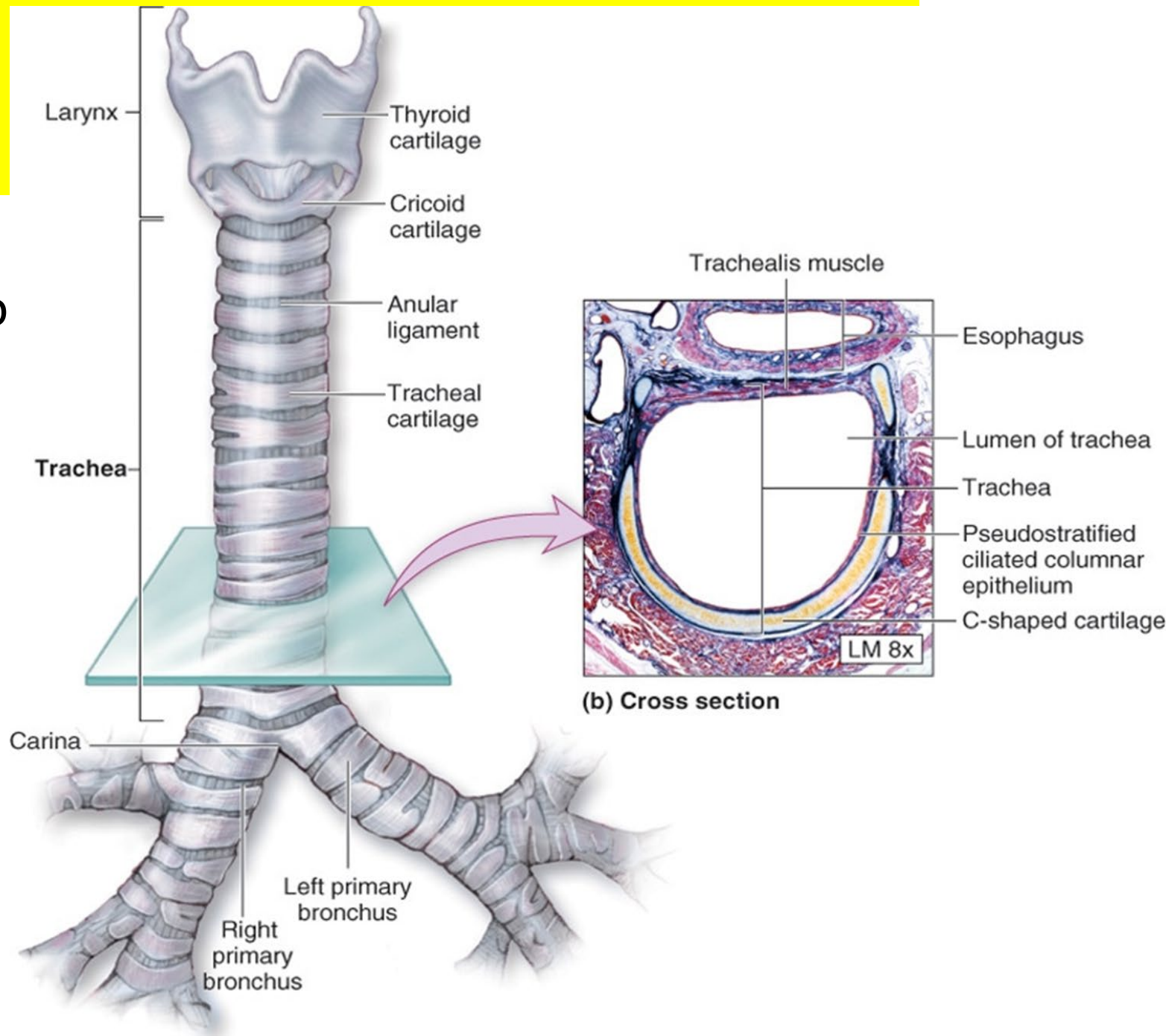
Olfactory Epithelium

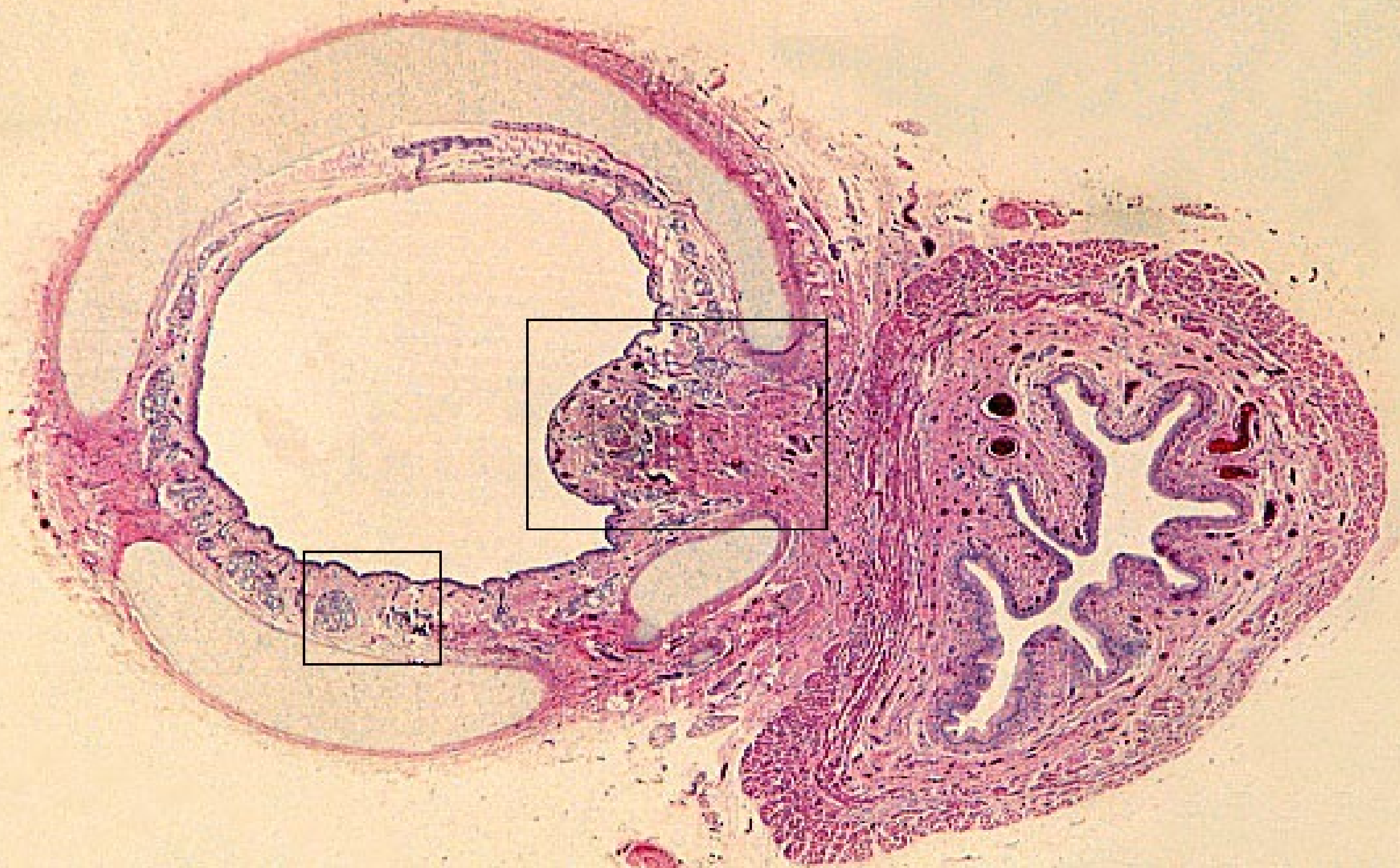
Respiratory histology facts

- The majority of the nasal cavity is lined by **respiratory epithelium**.
 - Respiratory epithelium is **pseudostratified columnar epithelium** with **goblet cells**.
 - The mucus secreted by **goblet cells**, as well as by **mucous glands**, helps filter and trap inspired particulate matter.
 - The moist mucus also contributes to **the humidification of inspired air**.
 - Cilia help sweep mucus to the pharynx where it is swallowed.
 - Respiratory epithelium is **underlain by a dense vasculature**.
 - **The blood helps warm inspired air**.
 - Mucus also contains lysozyme as well as immunoglobulins [IgA], which help prevent infection.
 - **The olfactory epithelium** is located in the most superior region of the nasal cavity and is involved in olfaction.
 - The nasal cavity is continuous with the nasopharynx via the posterior nasal apertures.
- As the bronchial tree branches, its histology changes markedly:
 - 1. Cartilage rings are replaced by cartilage plates, and within the bronchioles, cartilage is absent entirely.
 - 2. Epithelium changes from **pseudostratified columnar to simple columnar to simple cuboidal**.
 - 3. The number of cilia declines.
 - 4. The number of goblet cells declines.
 - 5. **The relative amount of smooth muscle increases**

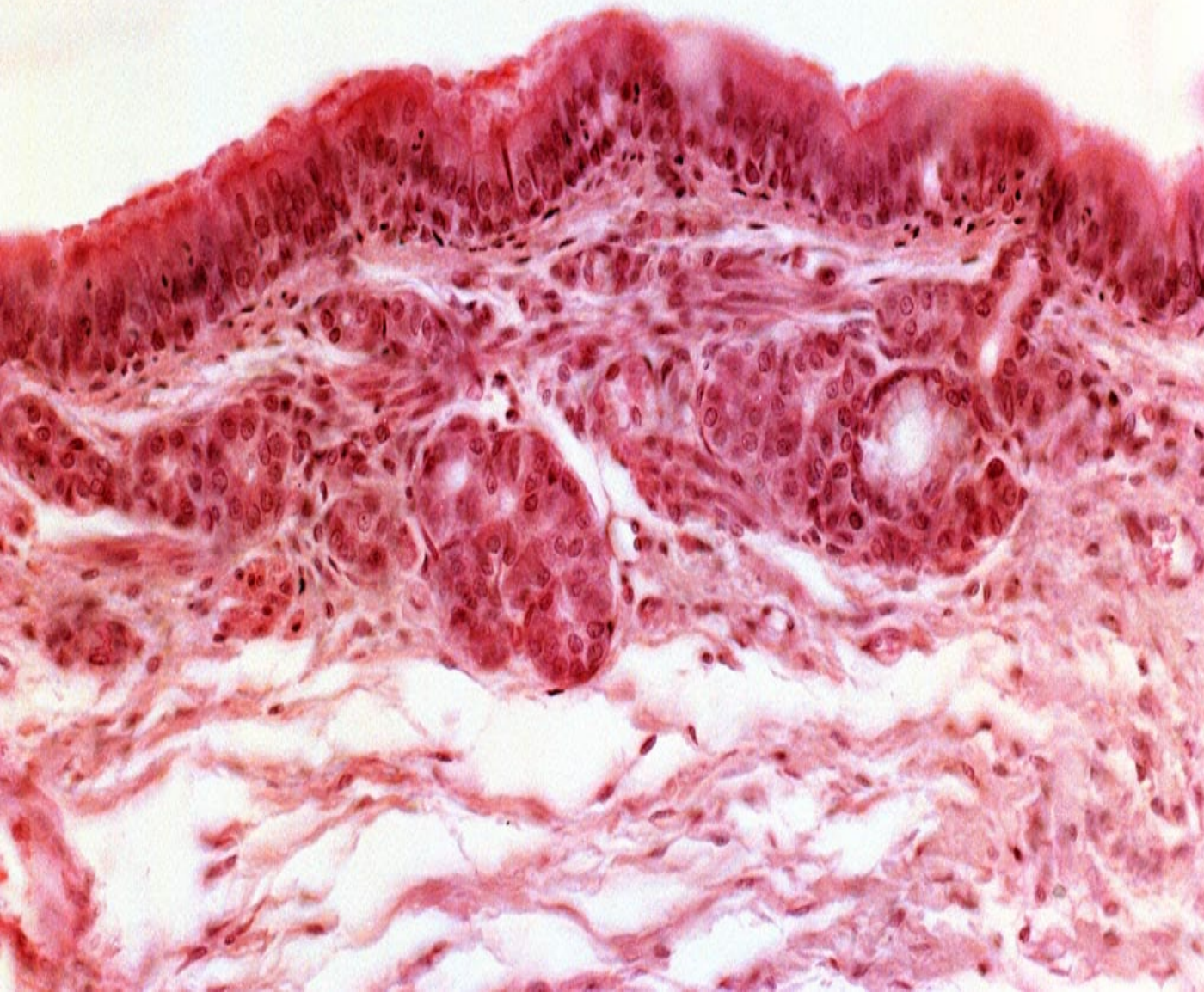
Trachea

- Flexible and mobile tube extending from the larynx into the mediastinum
- Composed of three layers
 - **Mucosa** – made up of goblet cells and ciliated epithelium
 - **Submucosa** – connective tissue deep to the mucosa
 - **Adventitia** – outermost layer made of C-shaped rings of hyaline cartilage





100 μm



Respiratory tree

Conducting zone

- a) **Large airways** :consist of nose, pharynx, larynx, trachea, and bronchi.
- b) **Small airways consist of** bronchioles that further divide into terminal bronchioles (**large numbers in parallel → least airway resistance**).
- **Warms, humidifies, and filters air but does not participate in gas exchange “anatomic dead space.”**
- **Cartilage and goblet cells extend to the end of bronchi.**
- **Pseudostratified ciliated columnar cells primarily make up epithelium of bronchus and extend to beginning of terminal bronchioles, then transition to cuboidal cells.**
- **Clear mucus and debris from lungs (mucociliary escalator).**
- **Airway smooth muscle cells extend to end of terminal bronchioles (sparse beyond this point).**

Respiratory zone

Lung parenchyma; consists of

- **respiratory bronchioles,**
- **alveolar ducts,**
- **alveoli.**

- **Participates in gas exchange.**

- **Mostly cuboidal cells in respiratory bronchioles, then simple squamous cells up to alveoli.**
- **Cilia terminate in respiratory bronchioles.**

- **Alveolar macrophages clear debris and participate in**
- **immune response**

Conducting zone

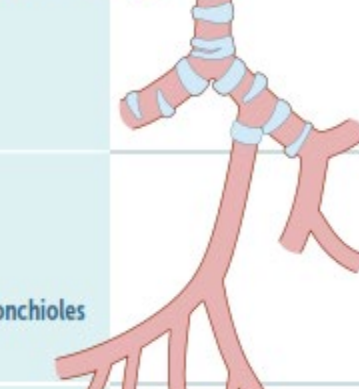
Trachea



Bronchi



Bronchioles

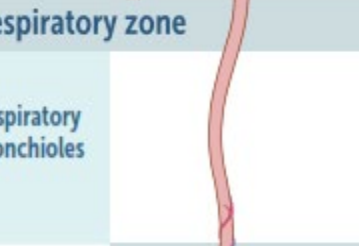


Terminal bronchioles

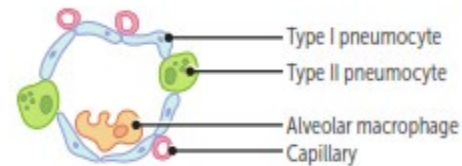
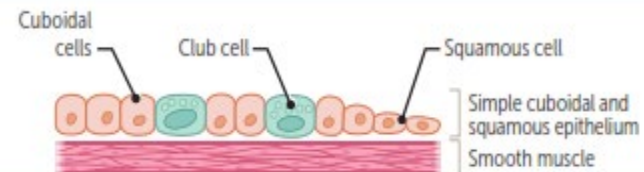
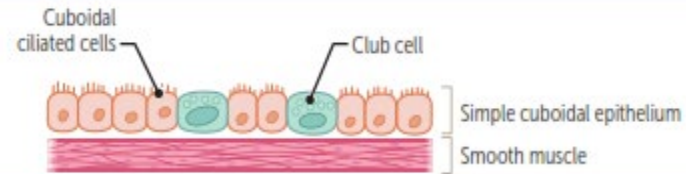
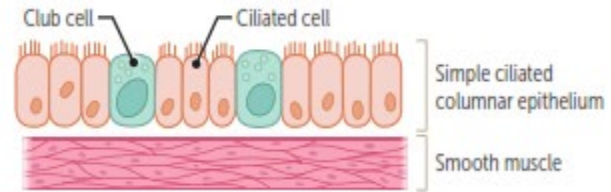
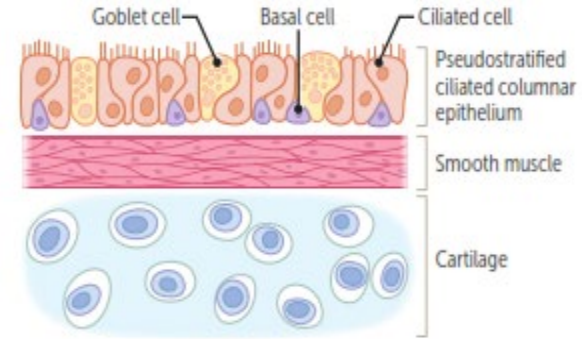


Respiratory zone

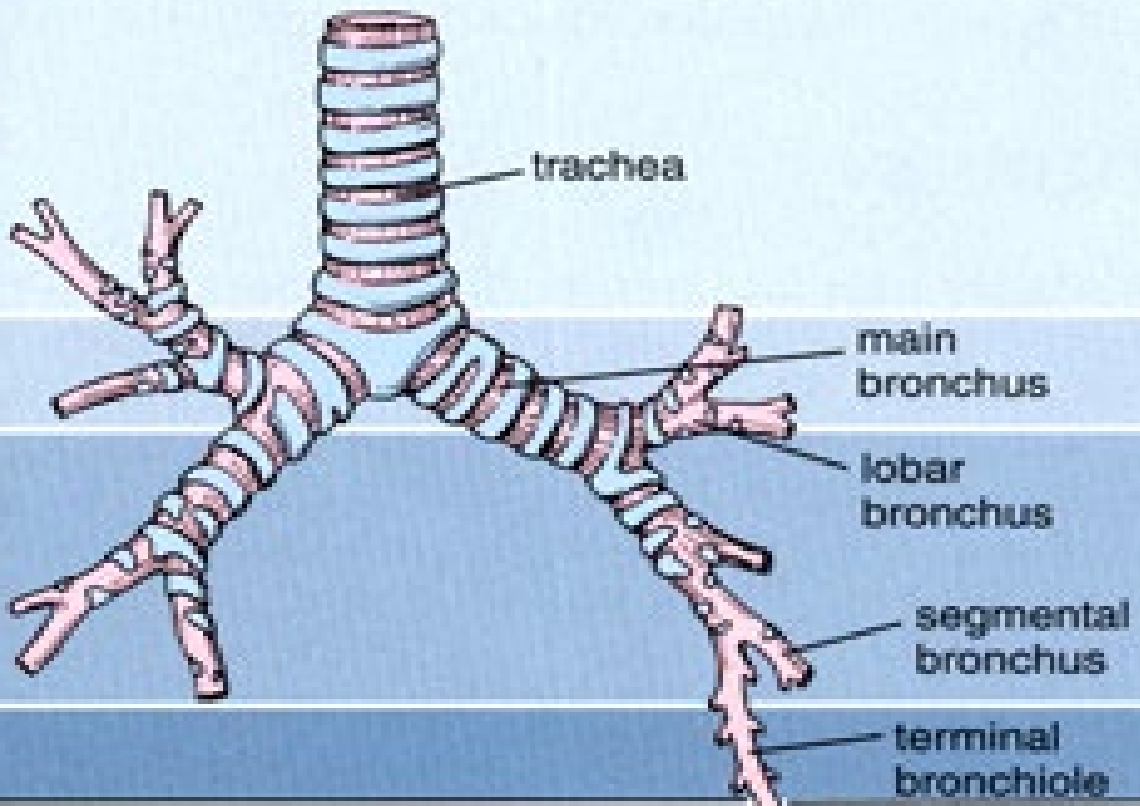
Respiratory bronchioles



Alveolar sacs

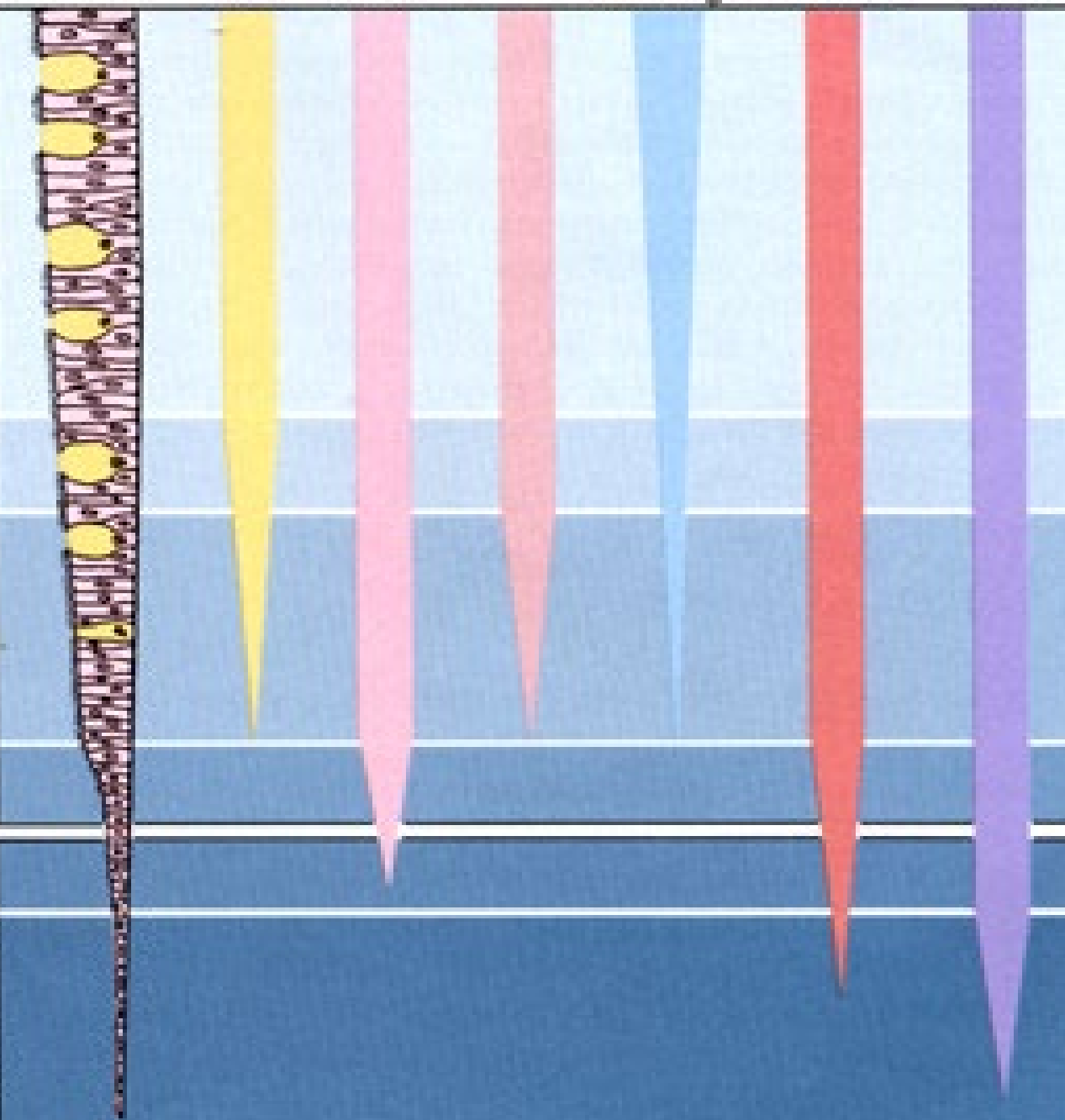


epithelium goblet cells ciliated cells glands hyaline cartilage smooth muscle elastic fibers



CONDUCTING

RESPIRATORY



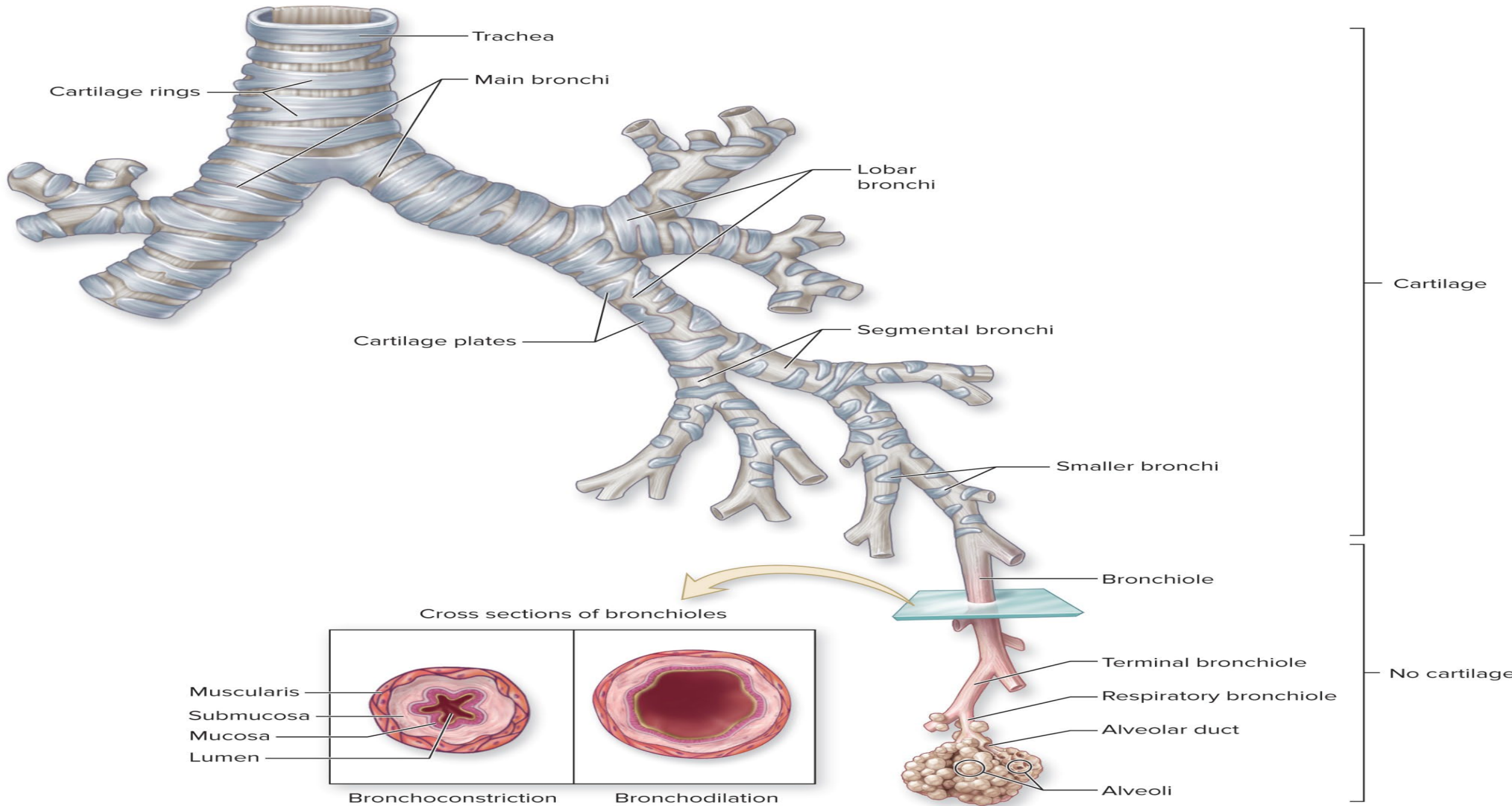
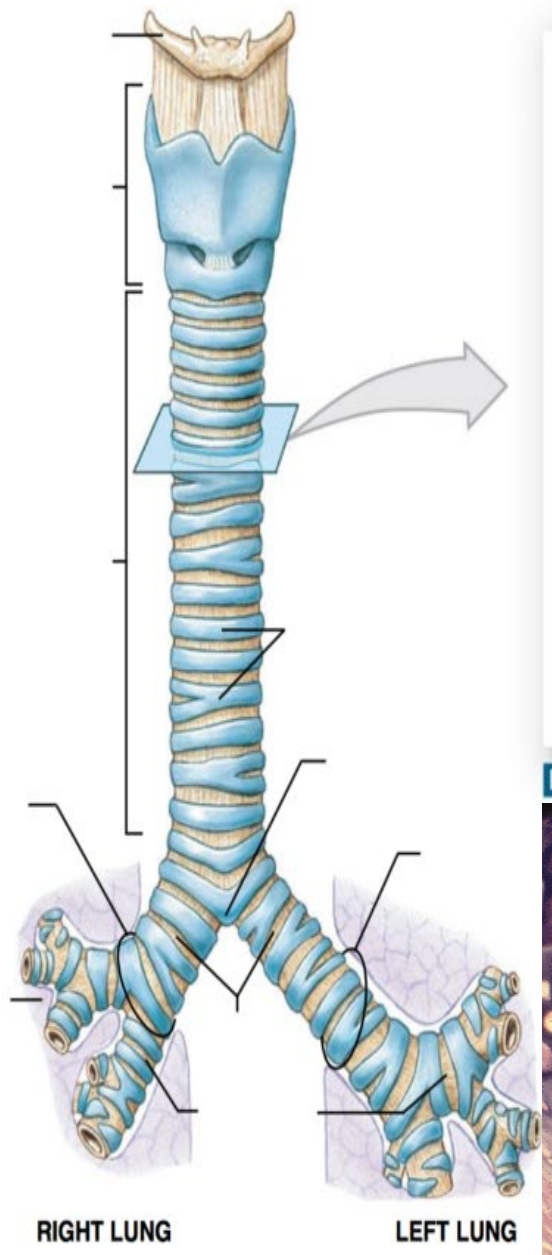


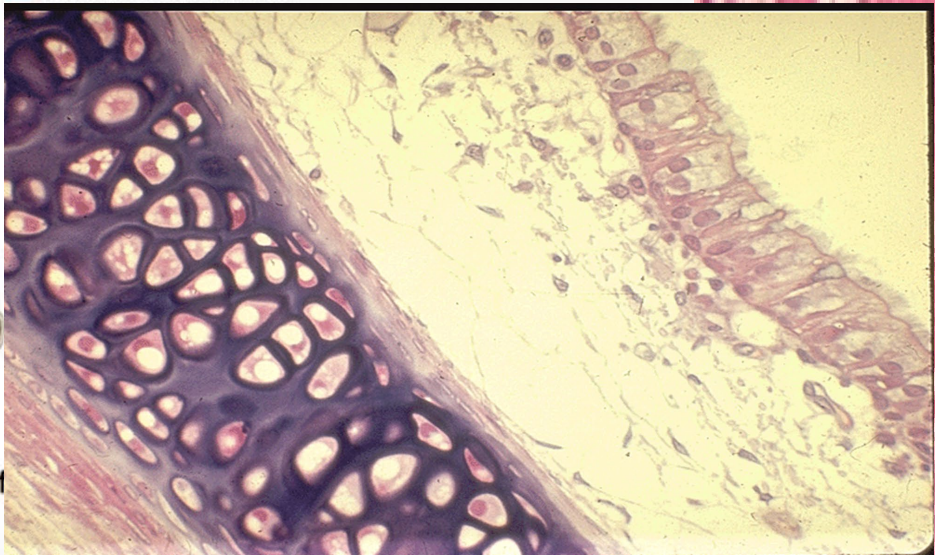
Figure 23-6 The Anatomy of the Trachea



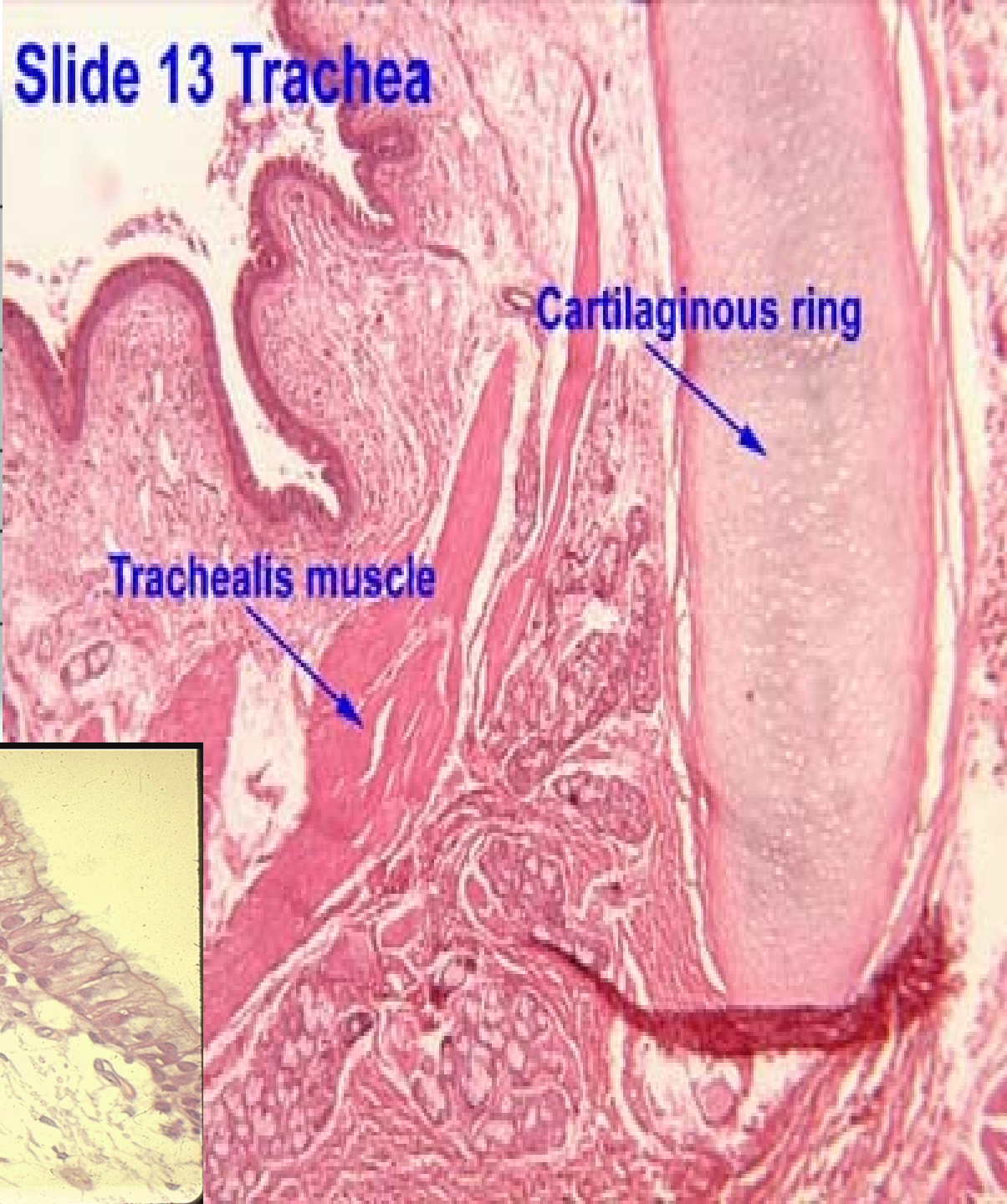
a A diagrammatic anterior view showing the plane of section for part (b)



b A cross-sectional view



Slide 13 Trachea

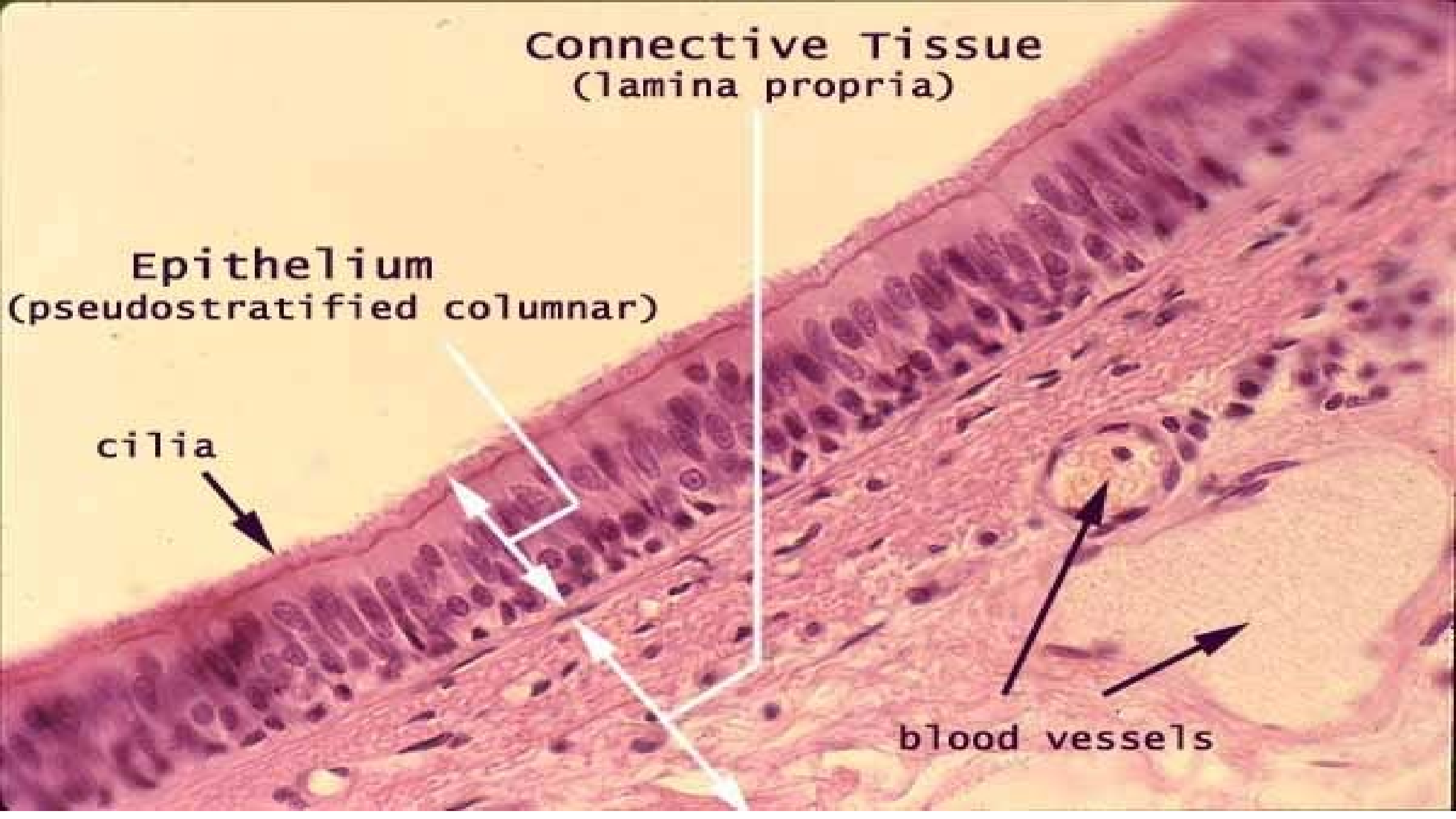


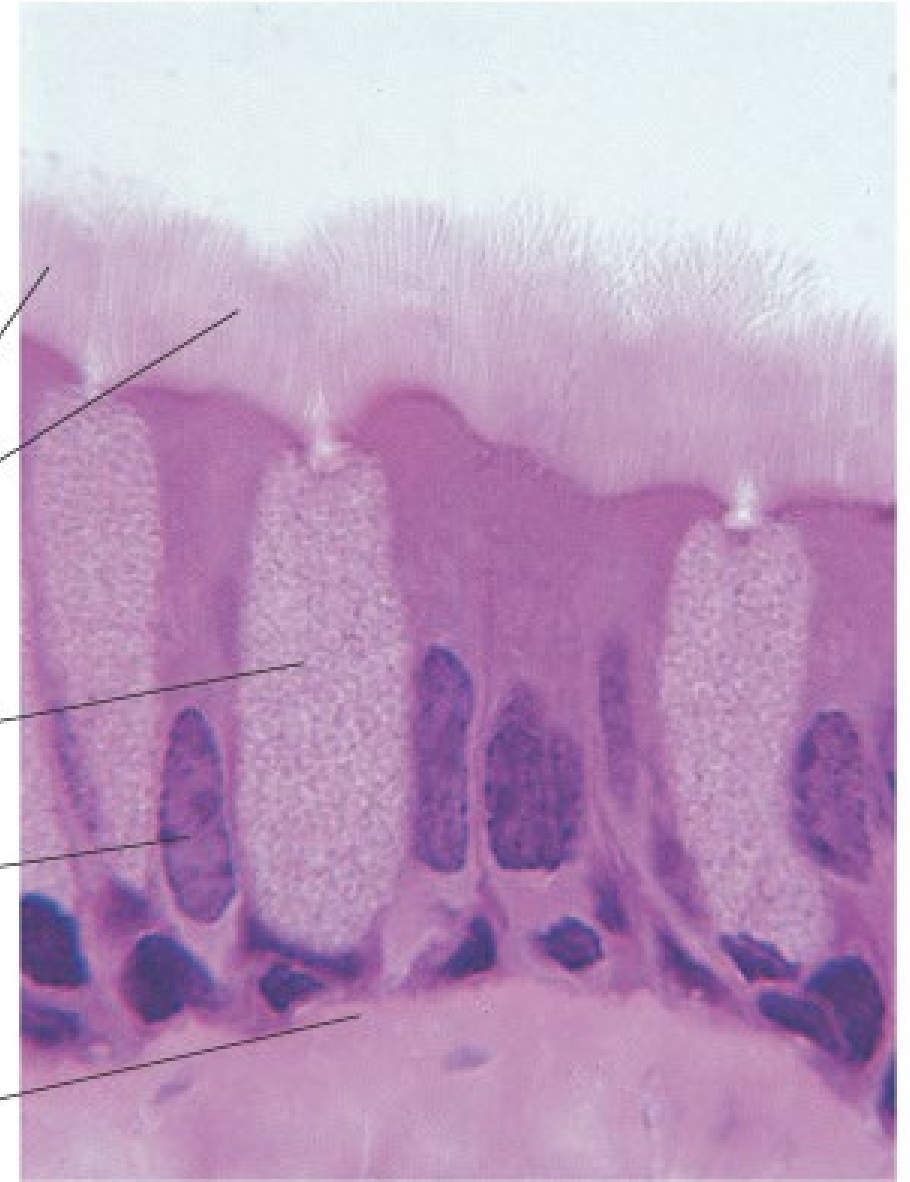
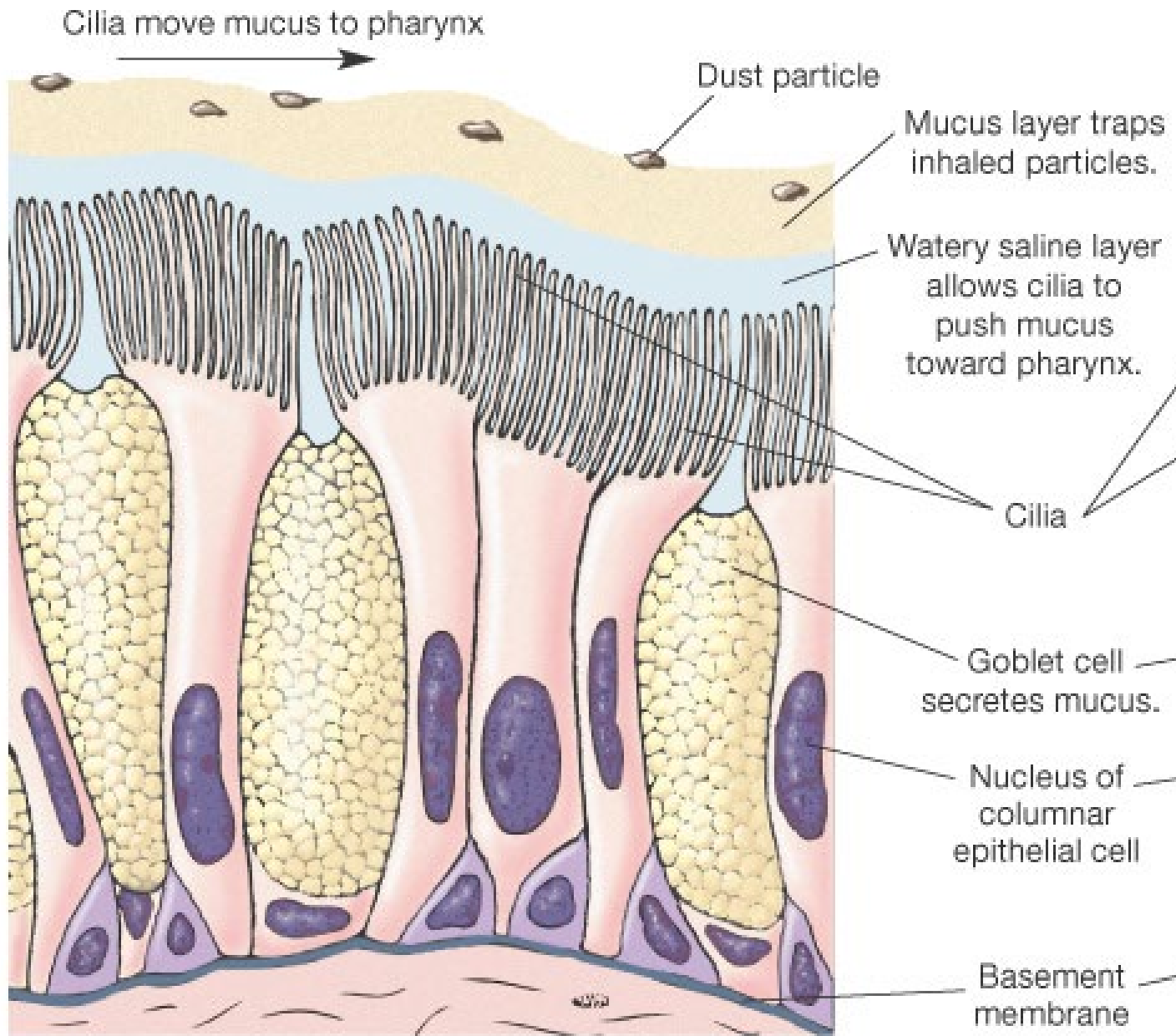
**Connective Tissue
(lamina propria)**

**Epithelium
(pseudostratified columnar)**

cilia

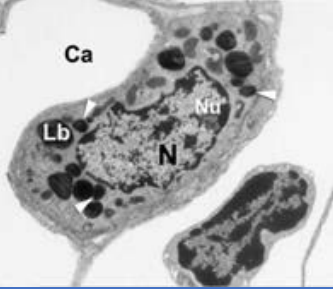
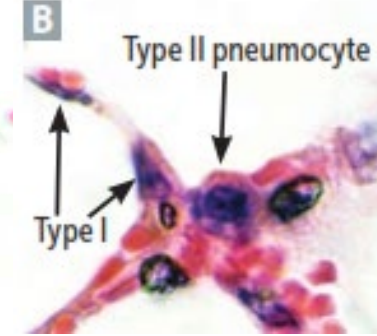
blood vessels





Ciliated epithelium of the trachea

Alveolar cell types

<h3>Type I pneumocytes</h3>	<ul style="list-style-type: none"> • 97% of alveolar surfaces. • Line the alveoli. • Squamous; thin for optimal gas diffusion. • Responsible for the conversion of the Angiotensin I to II and gas exchange
<h3>Type II pneumocytes</h3> 	<p>Secrete surfactant from lamellar bodies \Rightarrow \downarrow alveolar surface tension, \downarrow prevents alveolar collapse, \uparrow lung recoil, • compliance.</p> <ul style="list-style-type: none"> • Cuboidal and clustered B . • Also serve as precursors to type I cells and other type II cells. <p>Proliferate during lung damage.</p> 
<h3>Alveolar macrophages = DUST CELLS = MACROPHAGES</h3>	<ul style="list-style-type: none"> • Phagocytose foreign materials; • release cytokines and alveolar proteases. • Hemosiderin-laden macrophages may be seen in pulmonary hemorrhage.

Collapsing pressure (P) =

$$\frac{2 \text{ (surface tension)}}{\text{radius}}$$

- Alveoli have \uparrow tendency to collapse on expiration as radius \downarrow (law of Laplace).
- Pulmonary surfactant is a complex mix of
- lecithins, the most important of which is
- dipalmitoylphosphatidylcholine (DPPC).
- Surfactant synthesis begins around week 20 of gestation, but mature levels are not achieved until around week 35.
- Corticosteroids important for fetus surfactant production and lung development.

Club cells :

- **Nonciliated; low columnar/cuboidal with secretory granules.**
- **Located in bronchioles.**
- **Degrade** toxins; secrete component of surfactant; act as reserve cells.

Pneumocytes

Pseudocolumnar ciliated cells extend to the

respiratory bronchioles; goblet cells extend only to the terminal bronchioles.

Type I cells (97% of alveolar surfaces) line the alveoli. Squamous; thin for optimal gas diffusion.

Type II cells (3%) secrete pulmonary surfactant (dipalmitoyl phosphatidylcholine), which ↓ the alveolar surface tension. Cuboidal and clustered. Also serve as precursors to type I cells and other type II cells. Type II cells proliferate during lung damage.

Club cells

Clara cells—nonciliated; columnar with secretory granules. Secrete component of surfactant; degrade toxins; act as reserve cells.

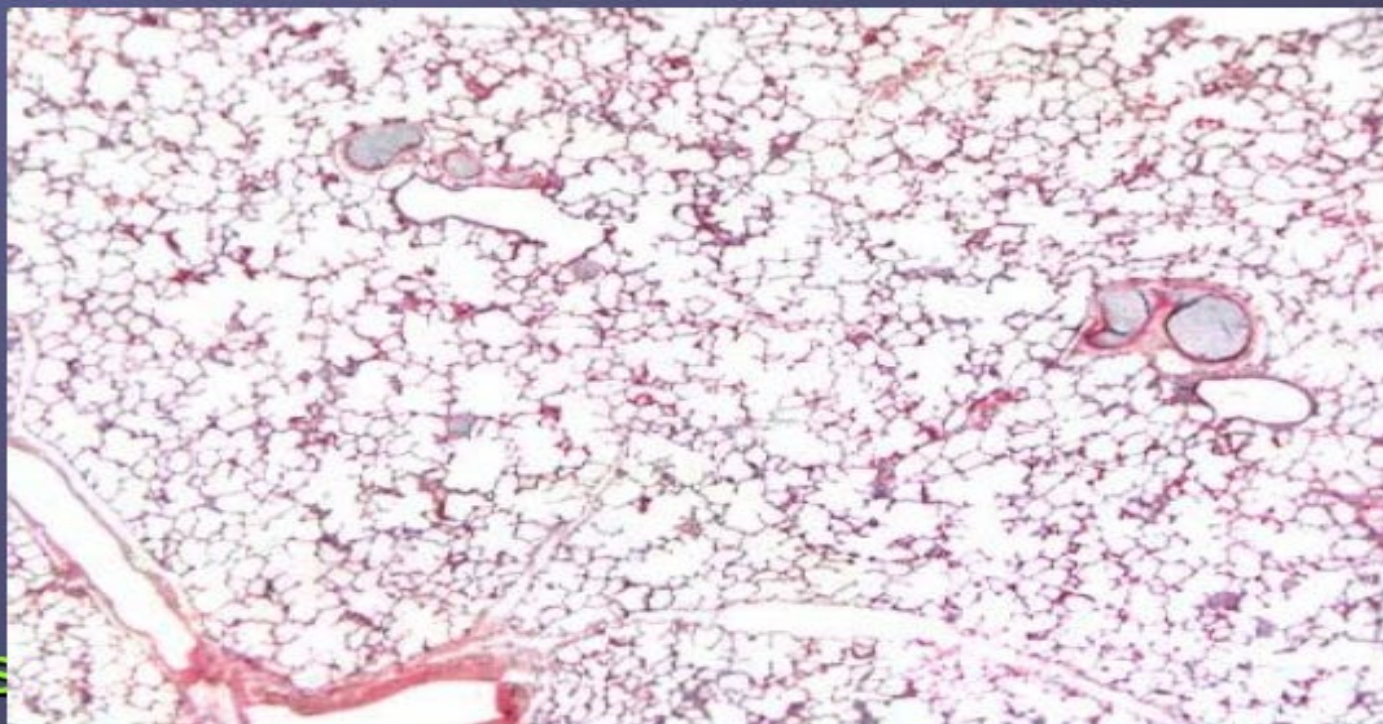
Mucus secretions are swept out of the lungs toward the mouth by ciliated cells.

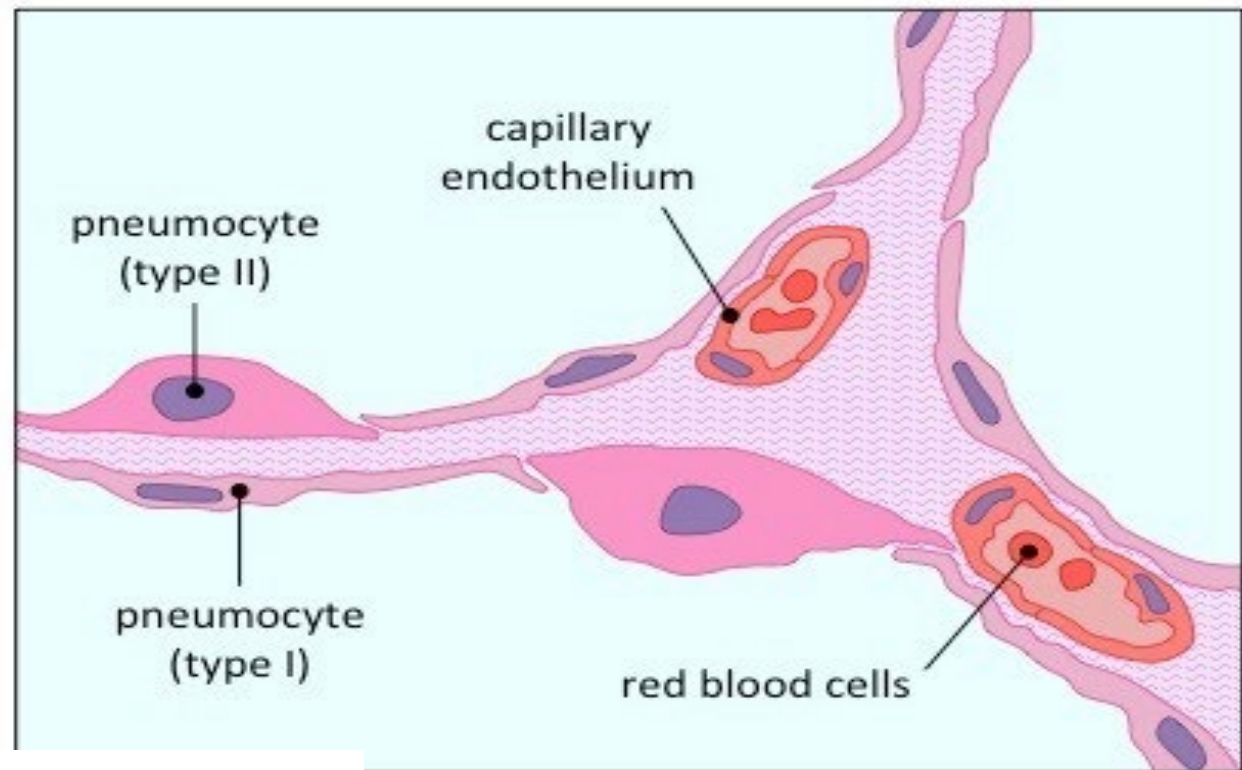
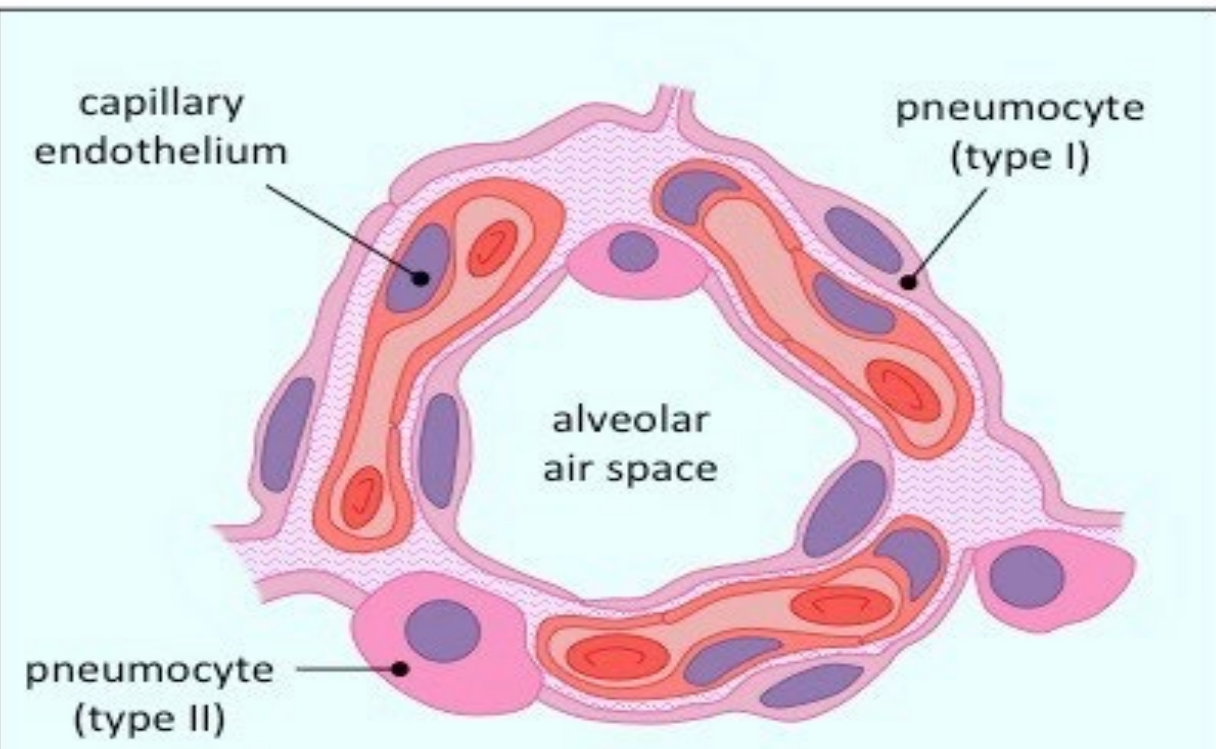
A lecithin-to-sphingomyelin ratio of > 2.0 in amniotic fluid is indicative of fetal lung maturity.

HISTOPATHOLOGY OF ALVEOLI

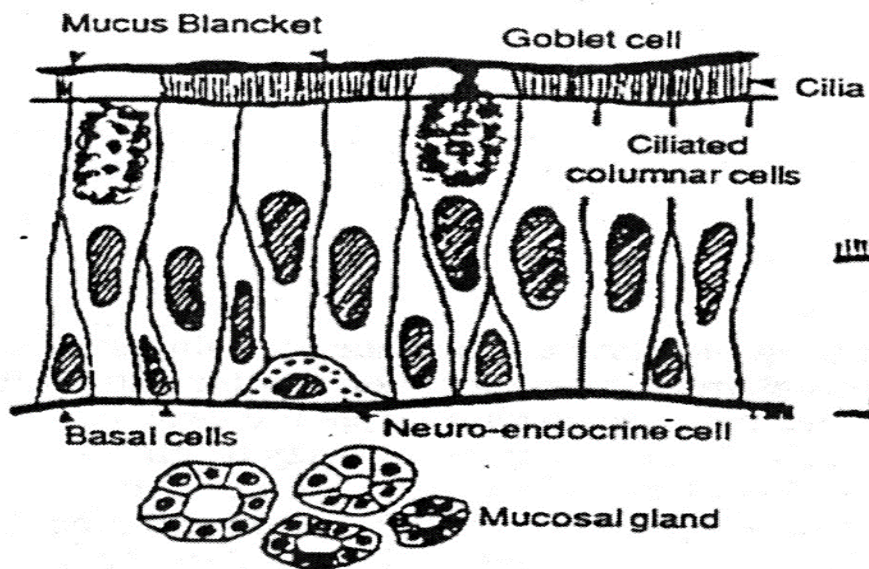
ALVEOLAR WALL

1. Alveolar epithelial cells-
 - Type I pneumocytes
 - Type II pneumocytes
2. Basement Membrane
3. Interstitial Space-
 - Collagen
 - Elastin
 - Unmyelinated Nerves
 - Macrophages
4. Capillary Basement Membrane
5. Capillary Endothelial Cells.

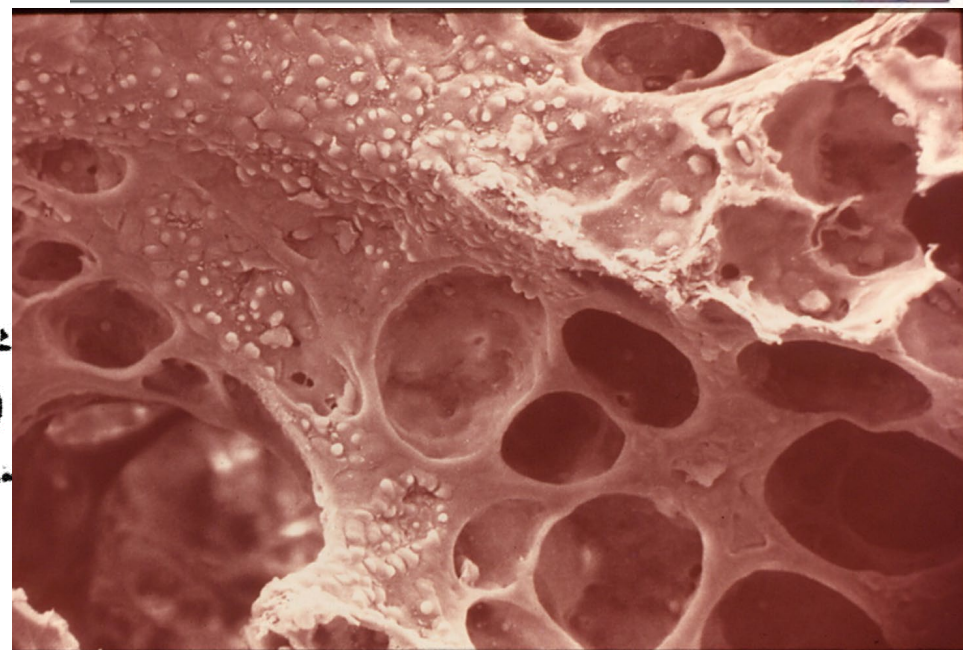
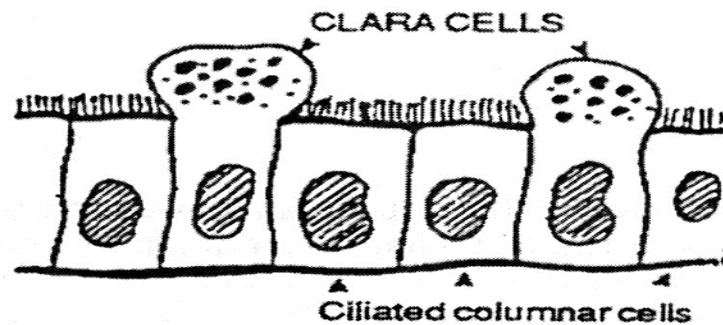


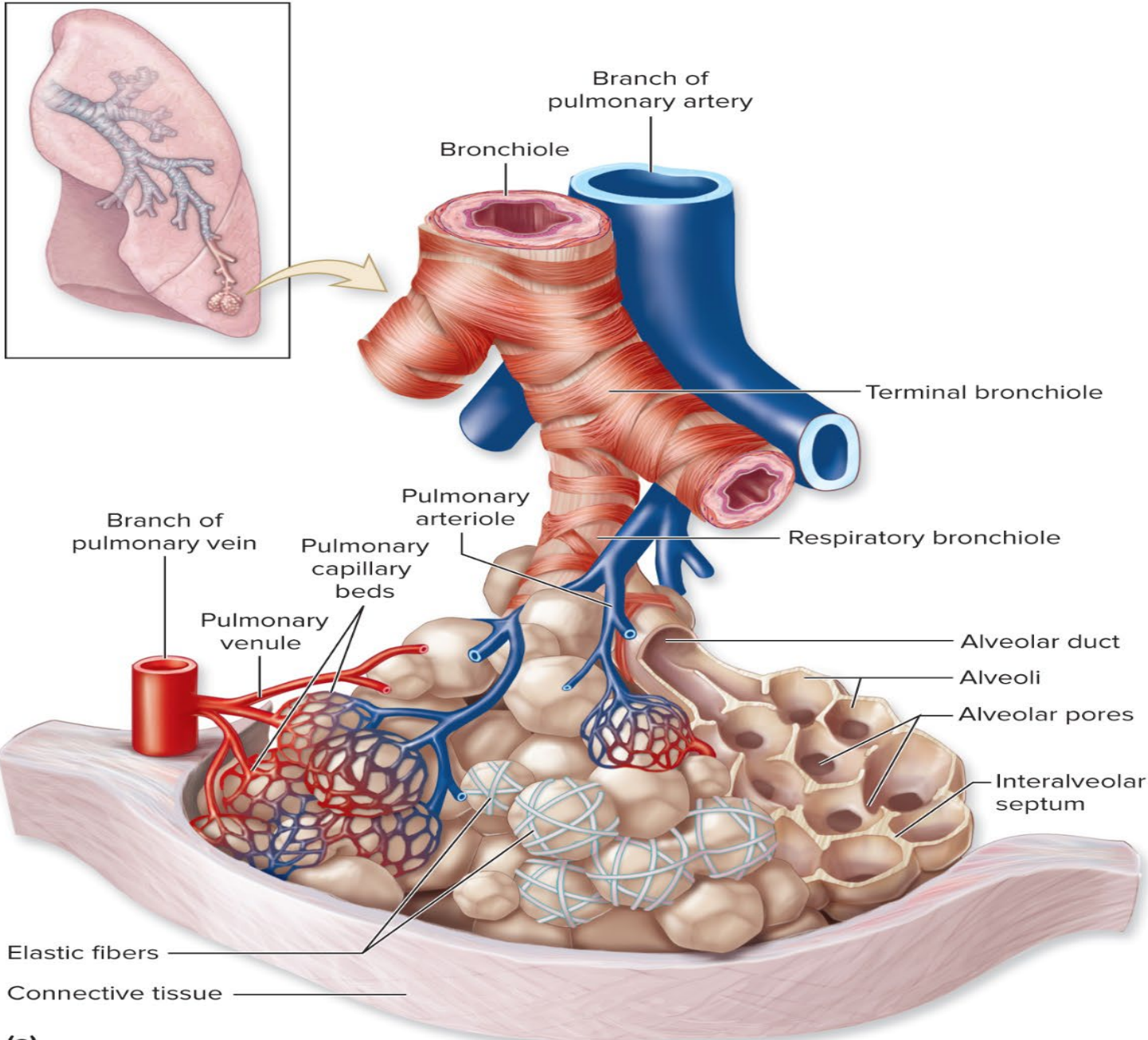


BRONCHUS

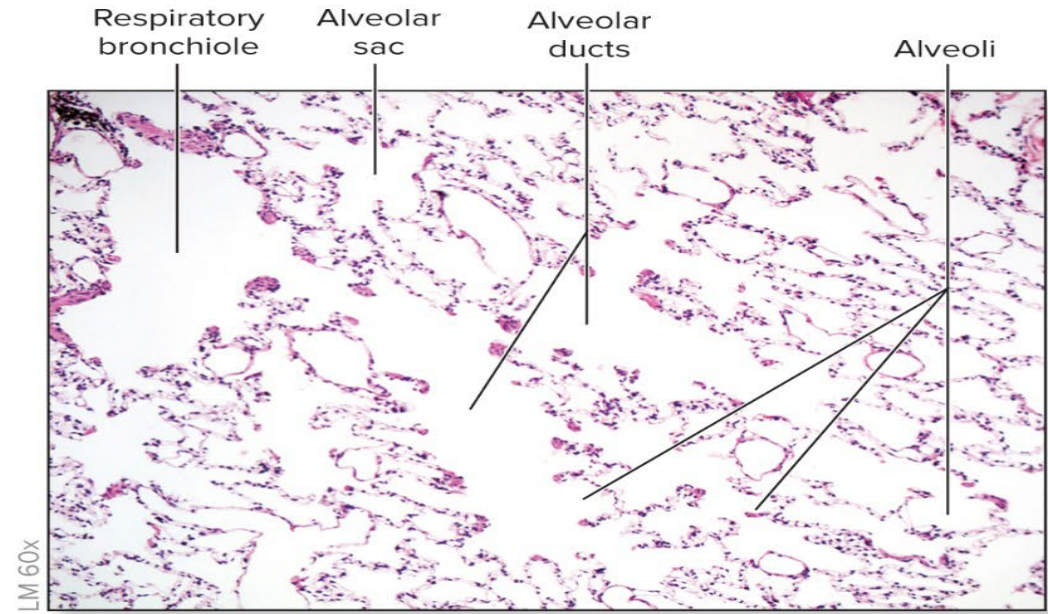


BRONCHIOLE

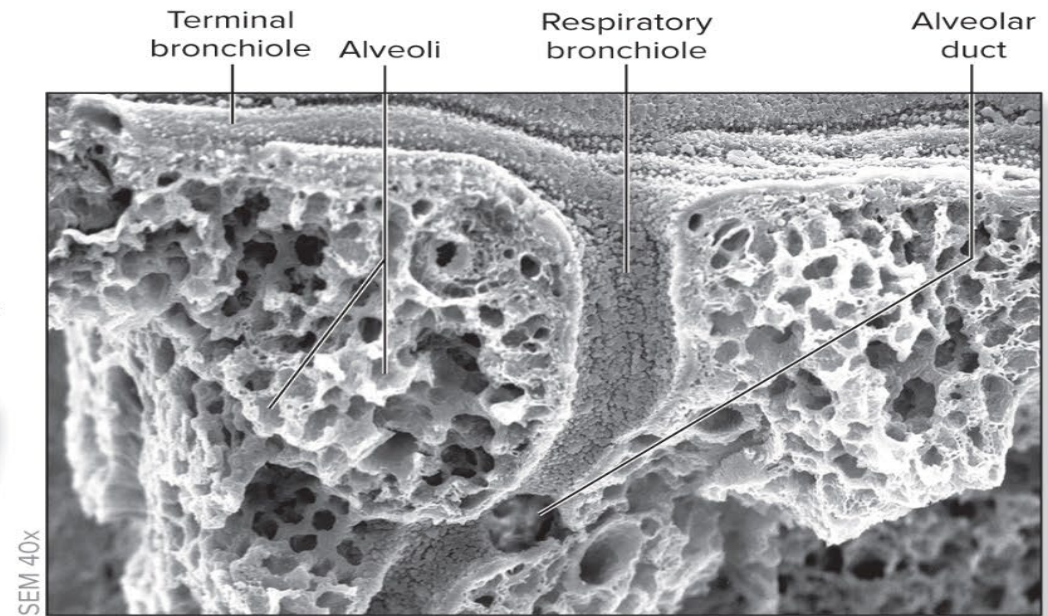




(a)

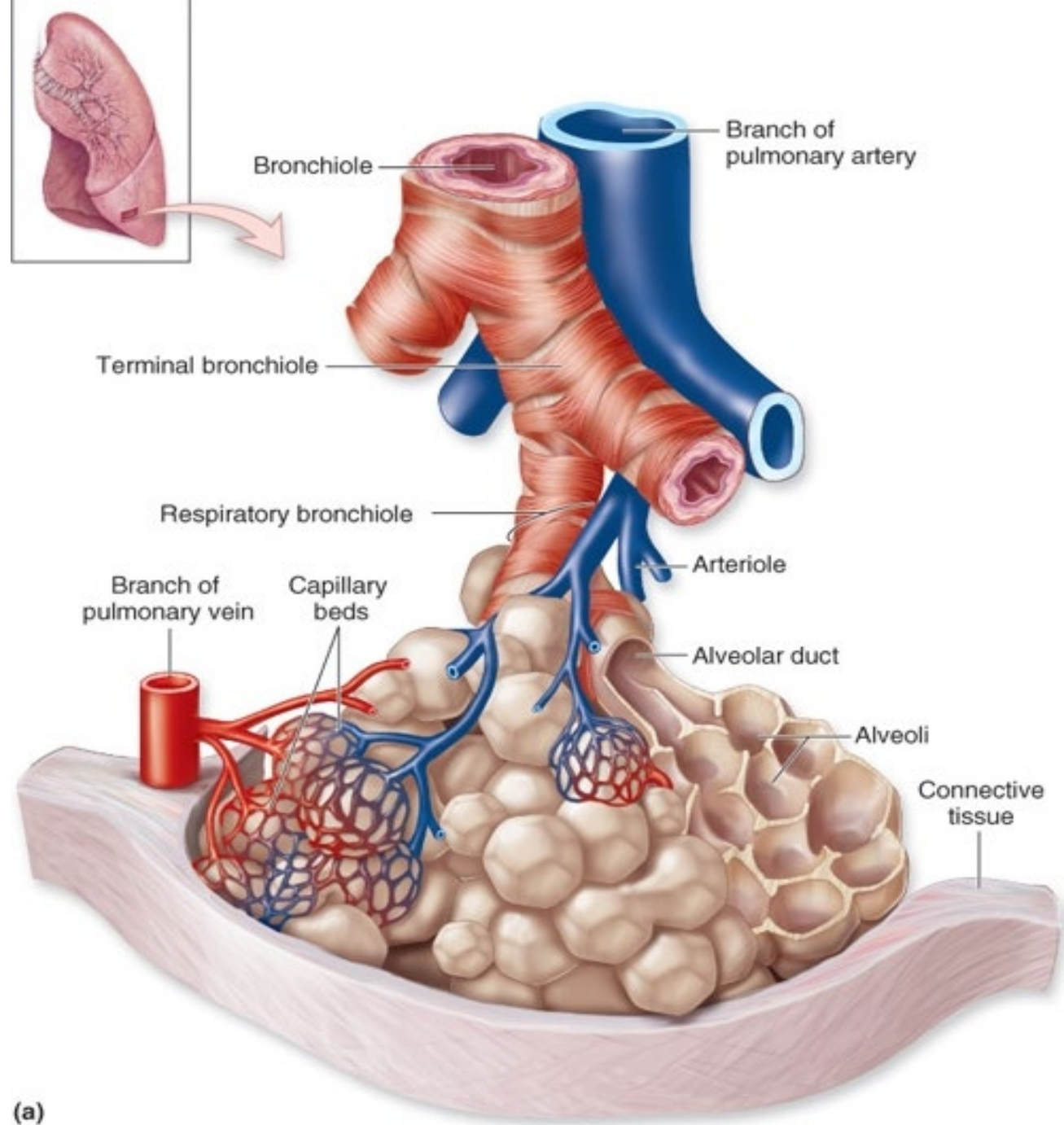
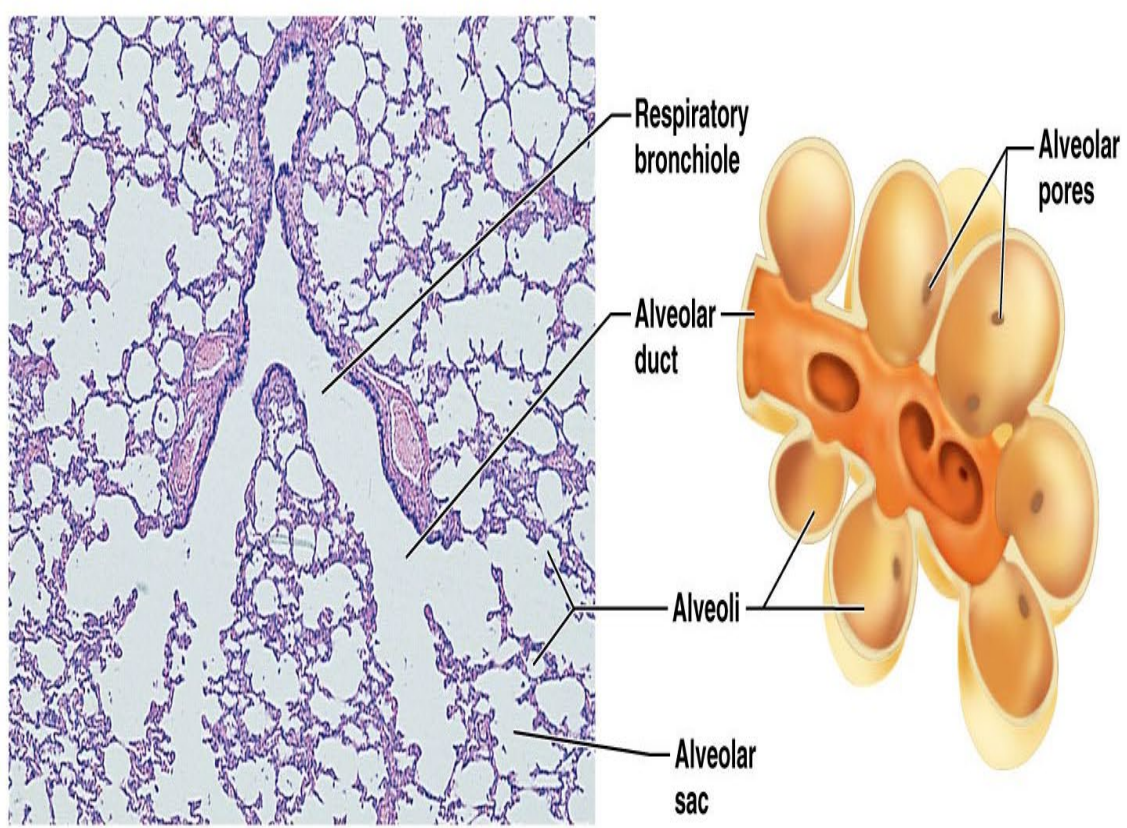


(b)



(c)

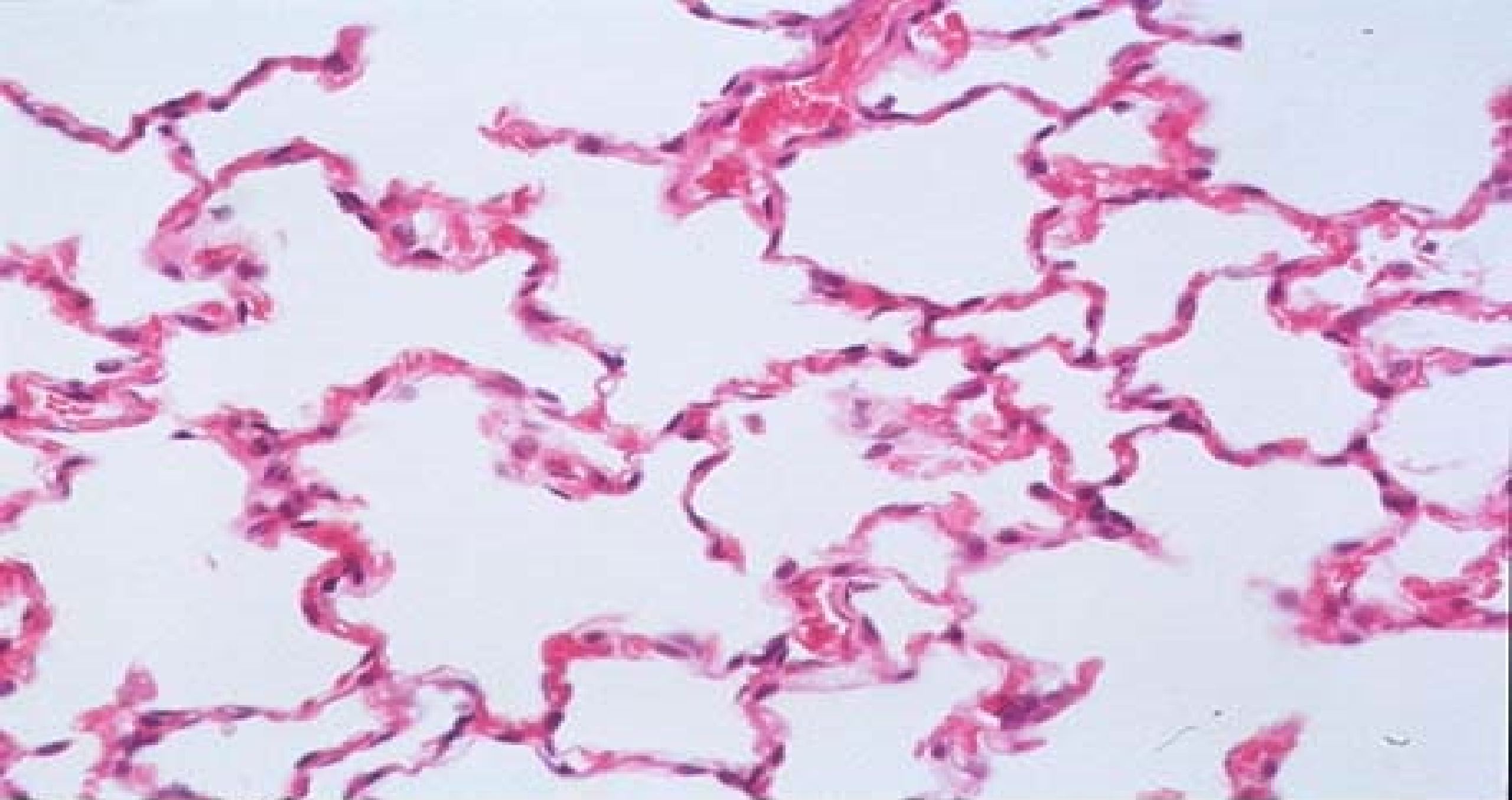
(b)



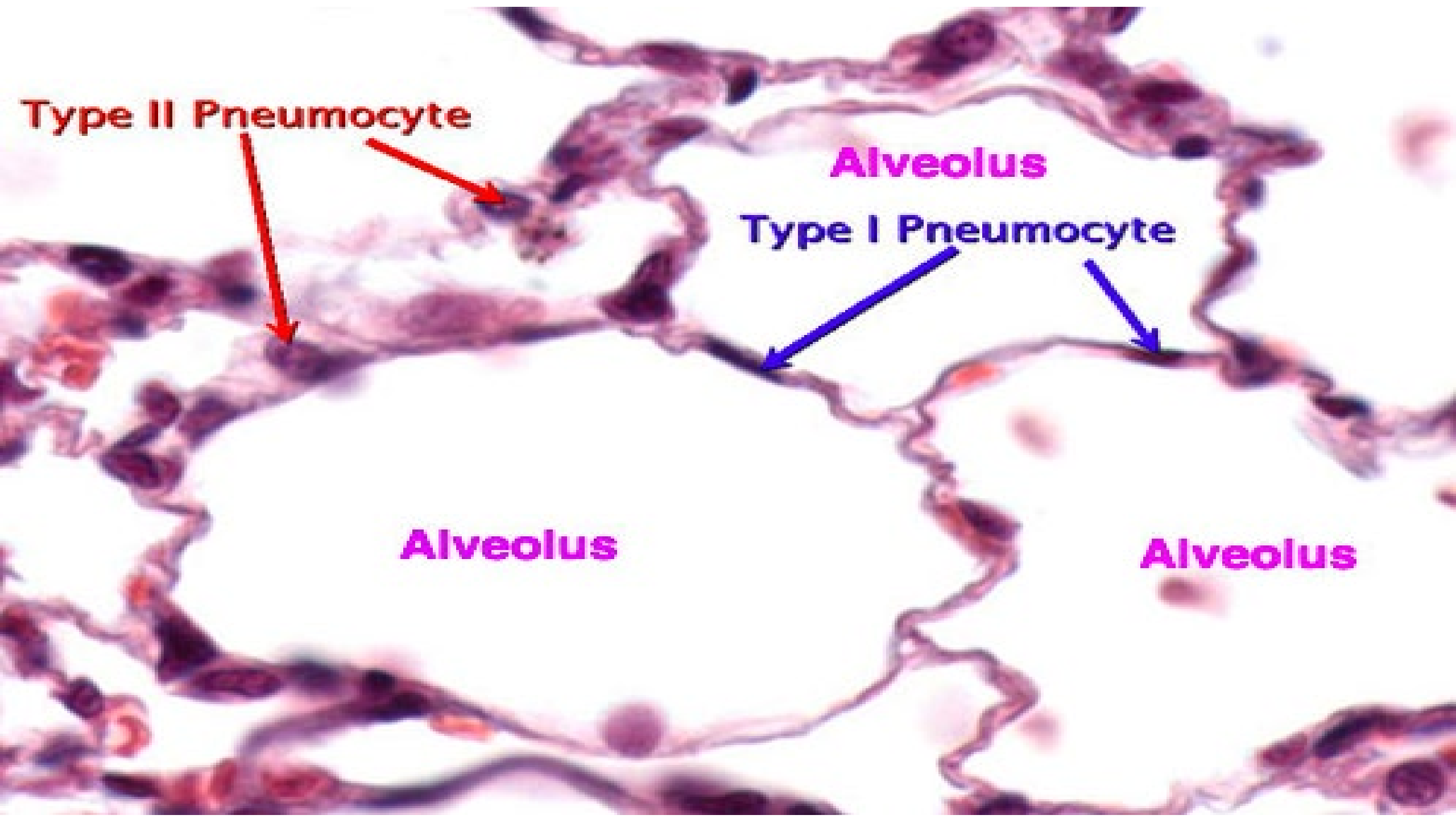
(a)

Respiratory Zone

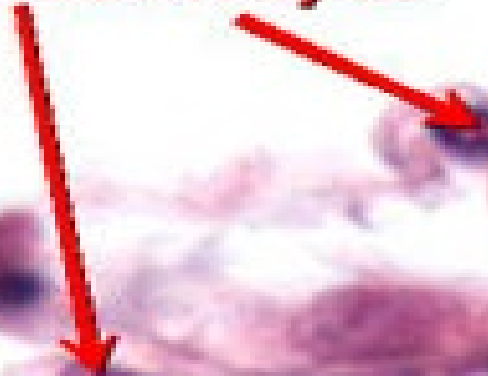
Figure 22.80



Lung 400x



Type II Pneumocyte



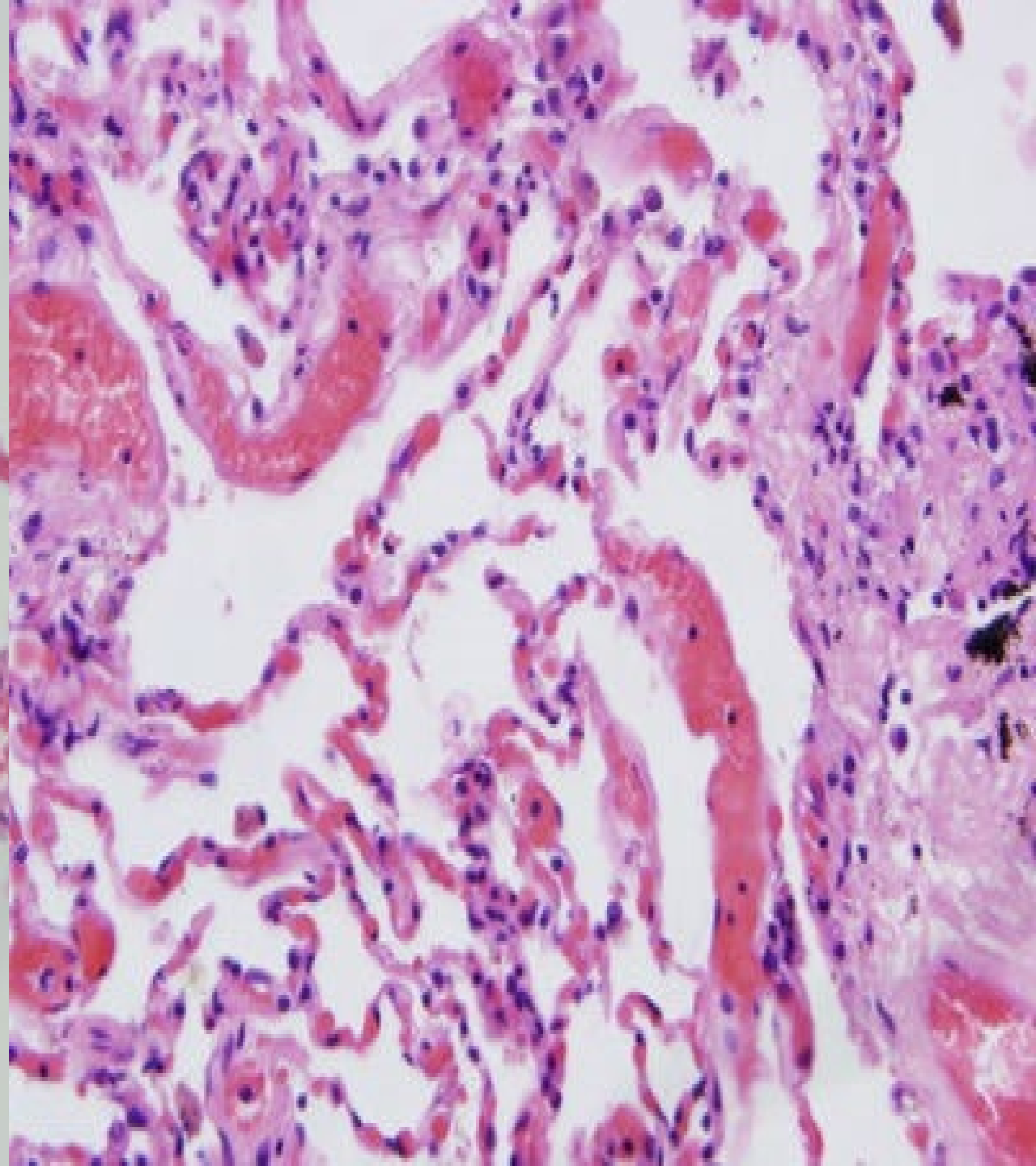
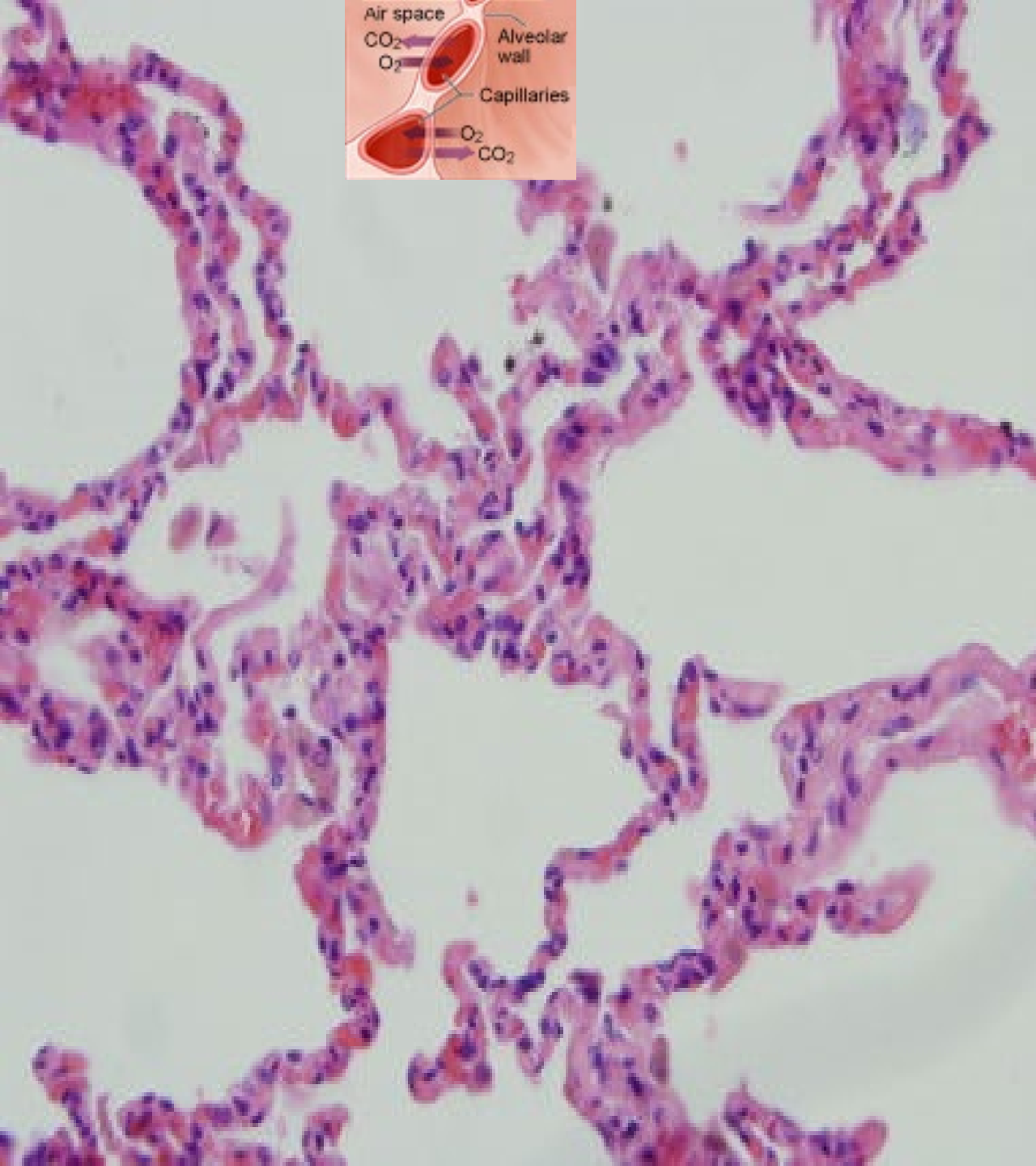
Alveolus

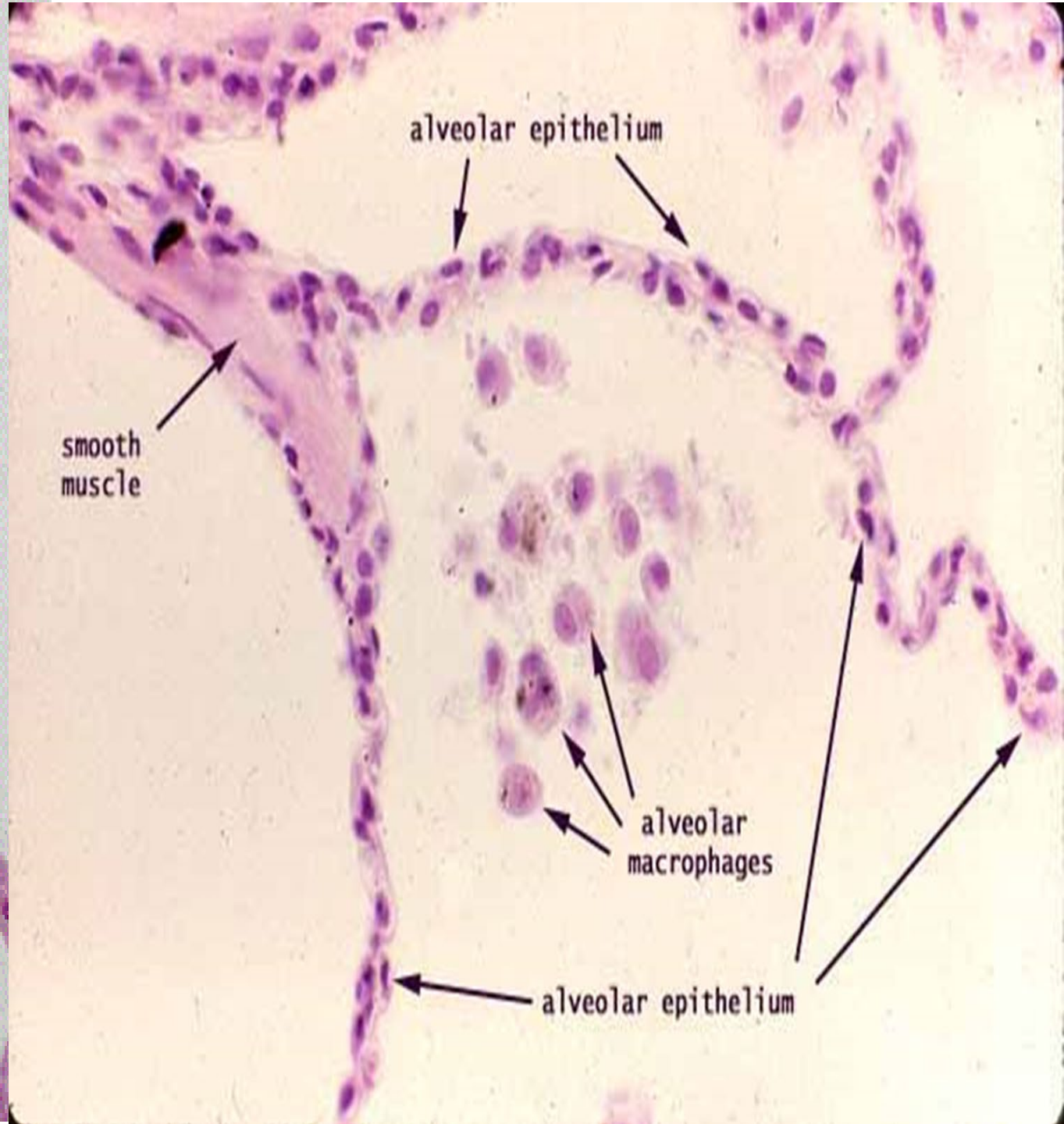
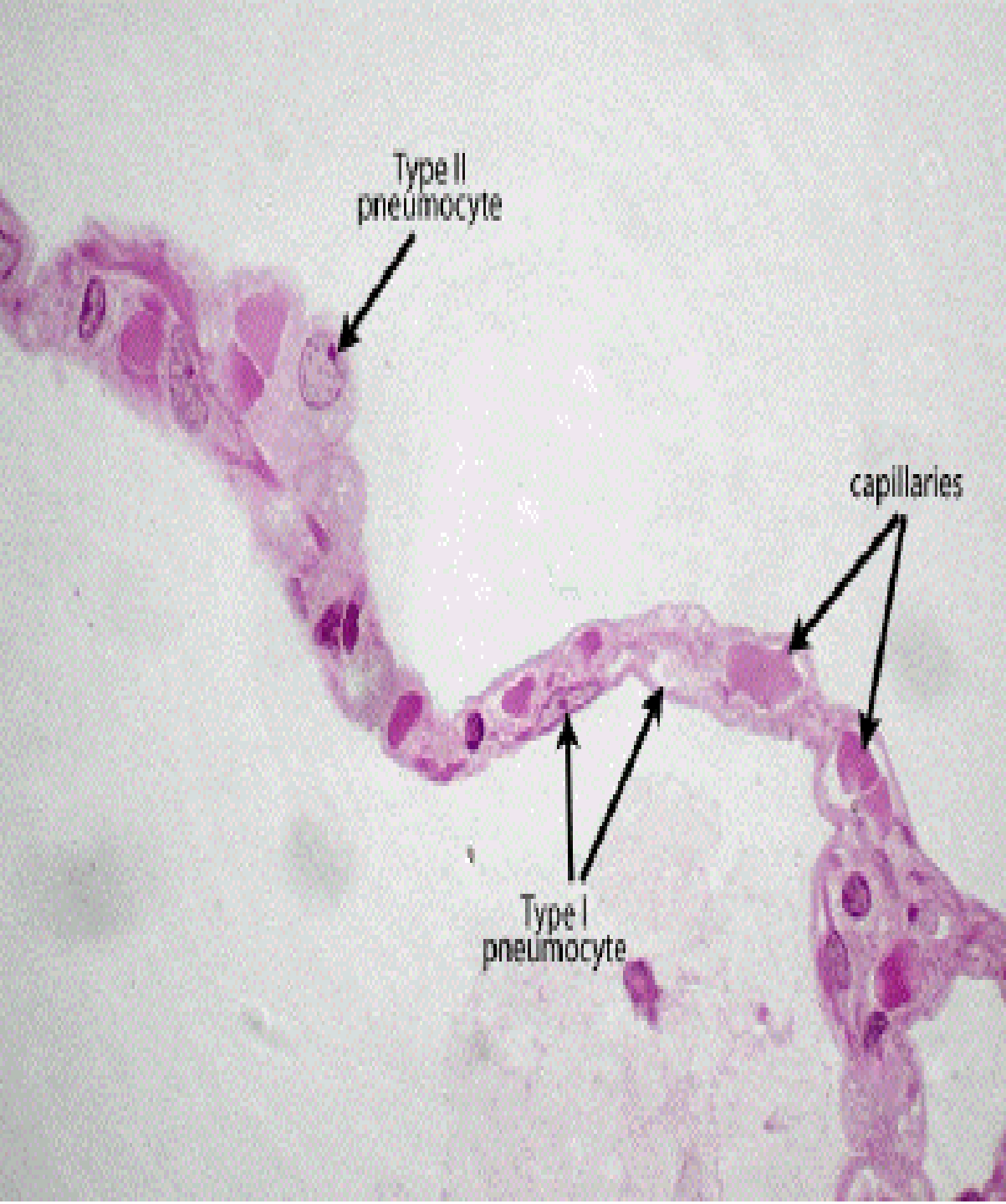
Type I Pneumocyte

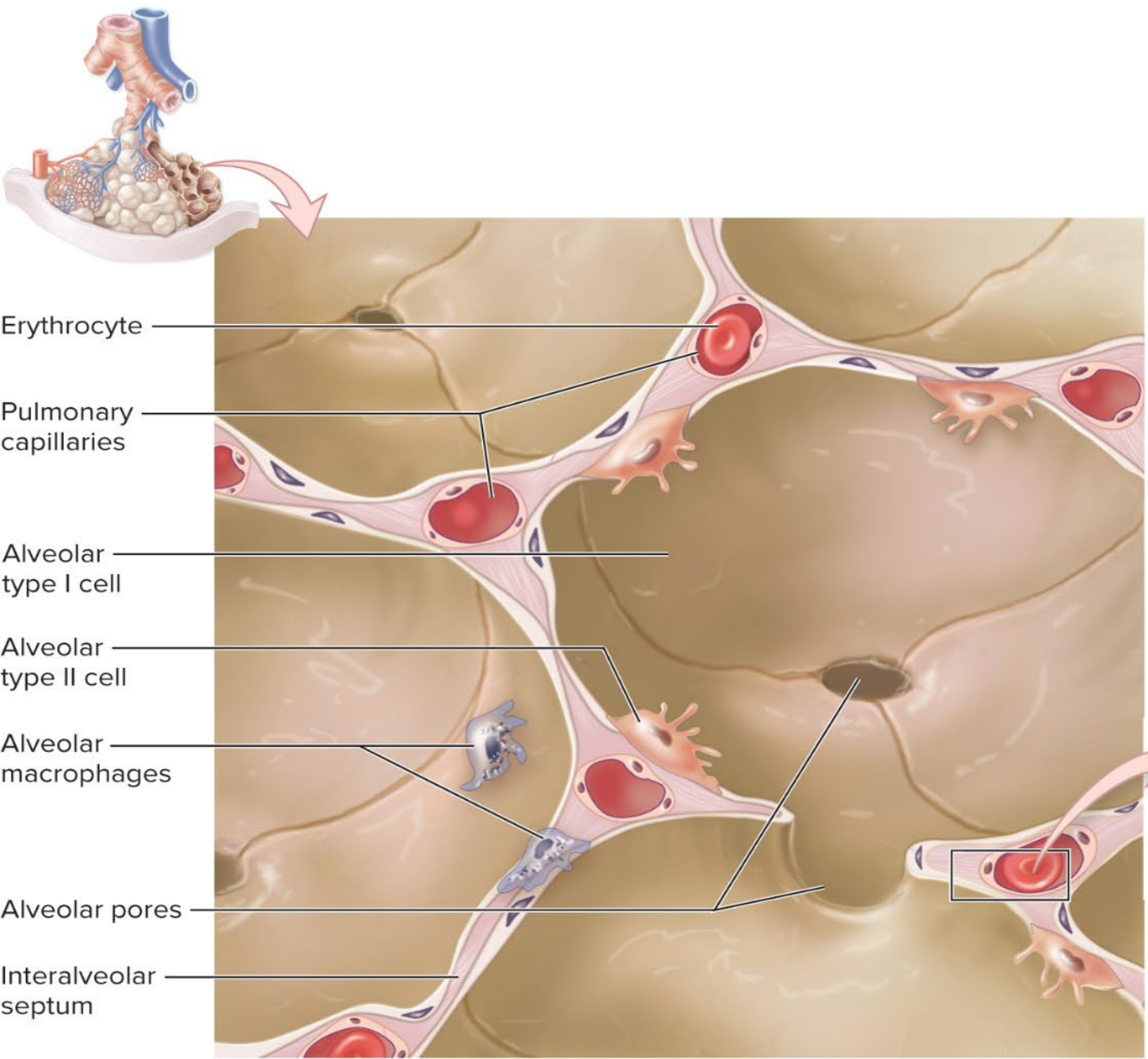


Alveolus

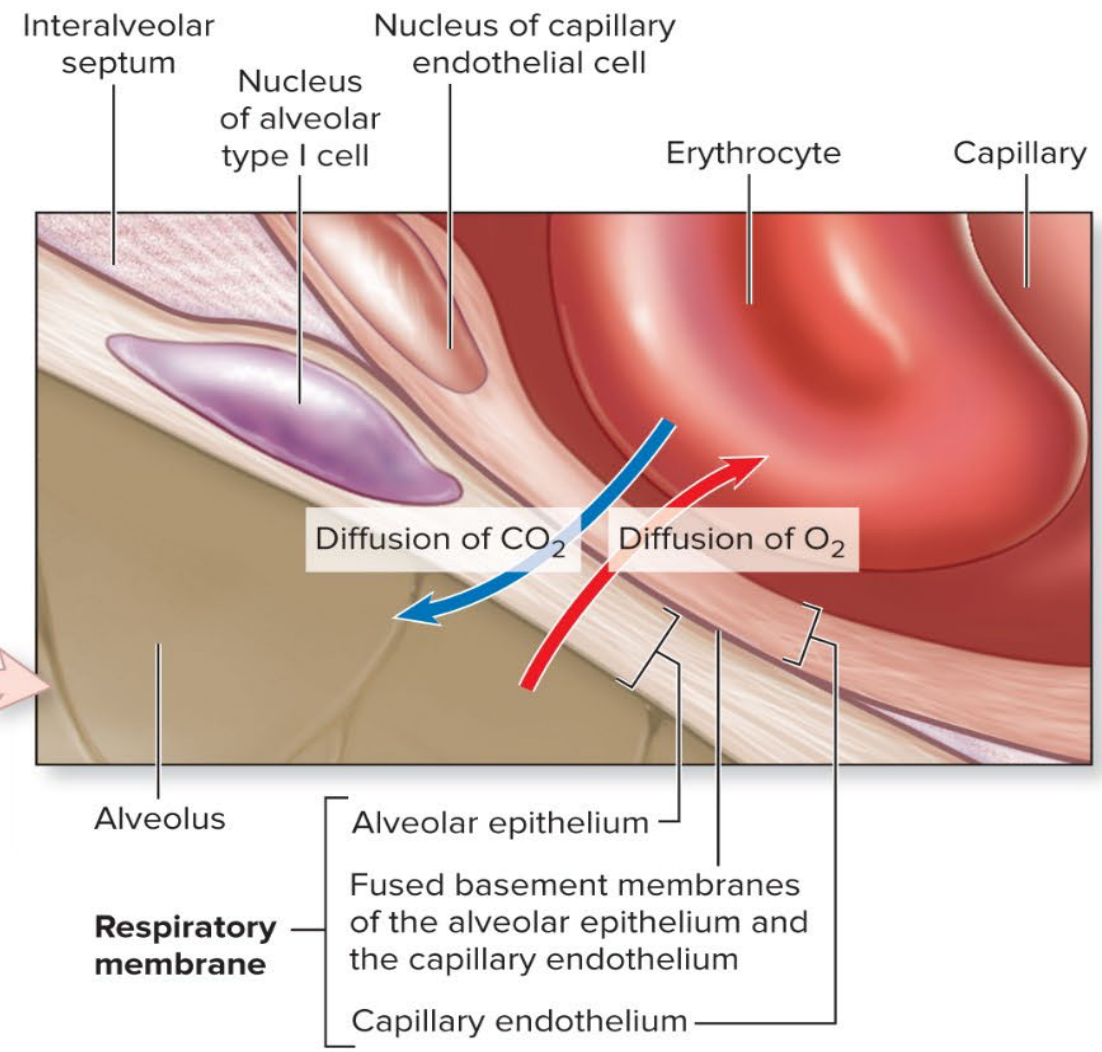
Alveolus



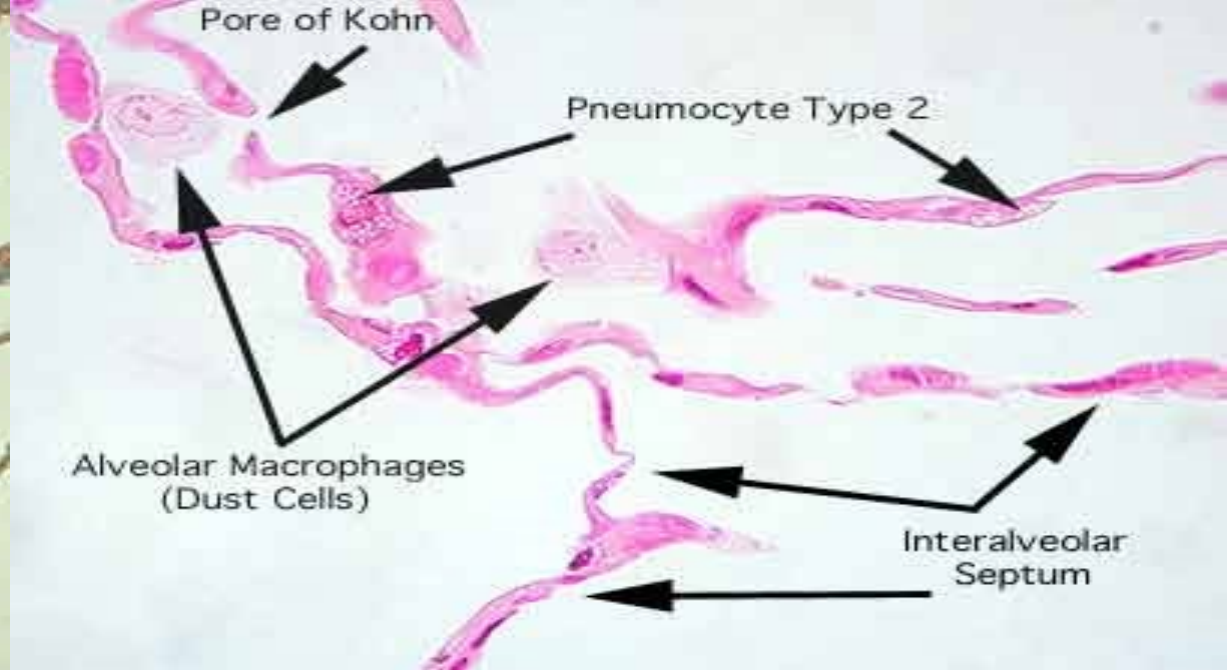
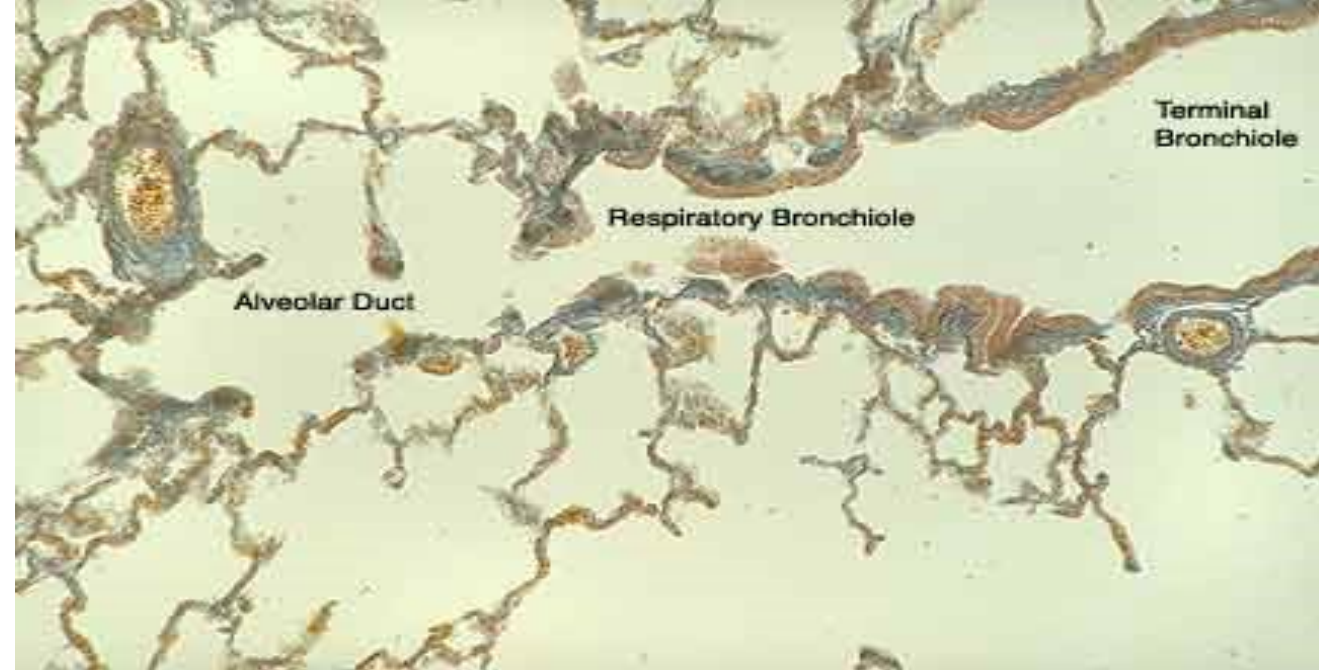




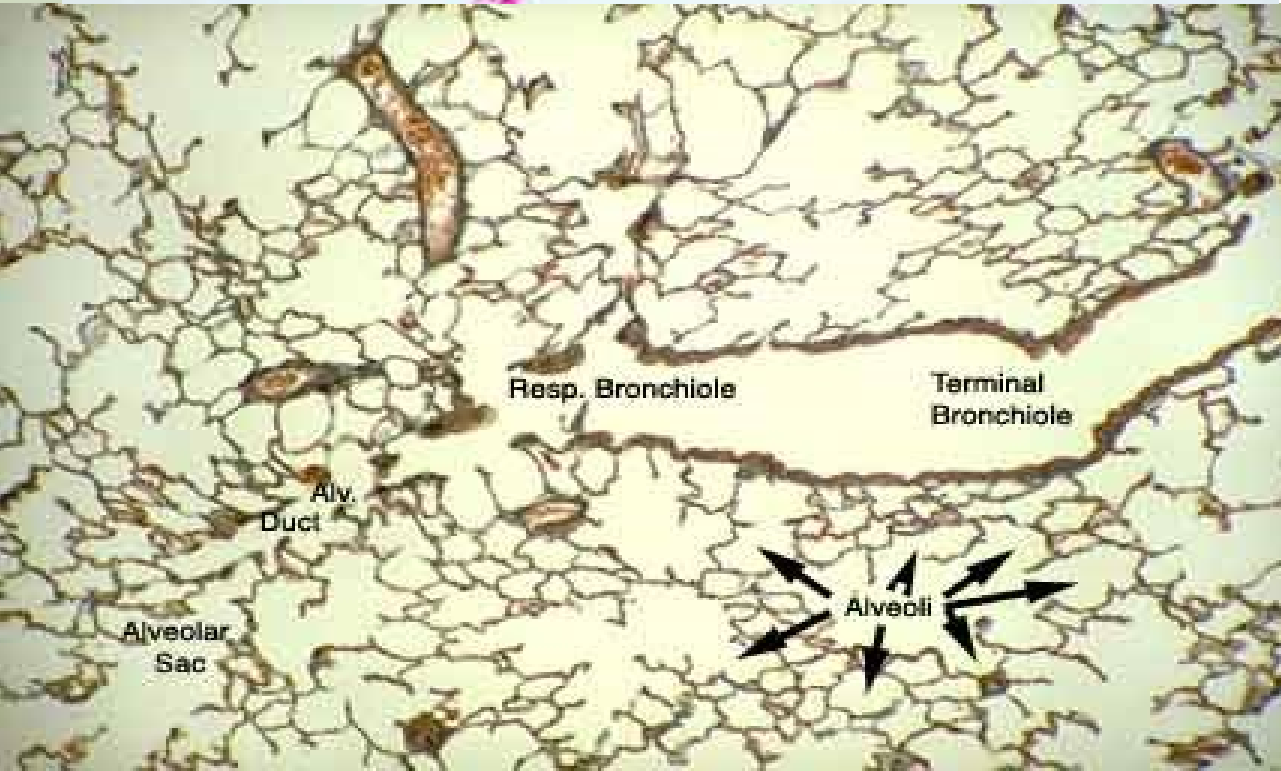
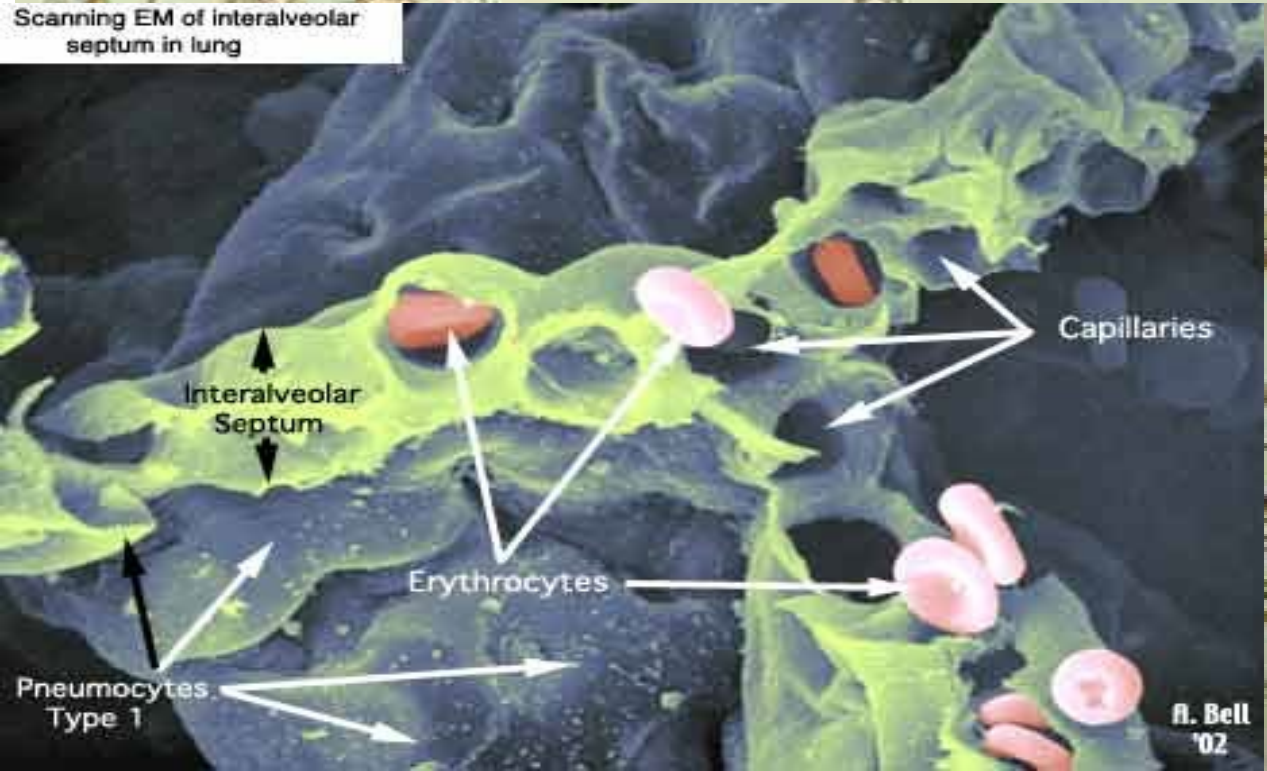
(a)

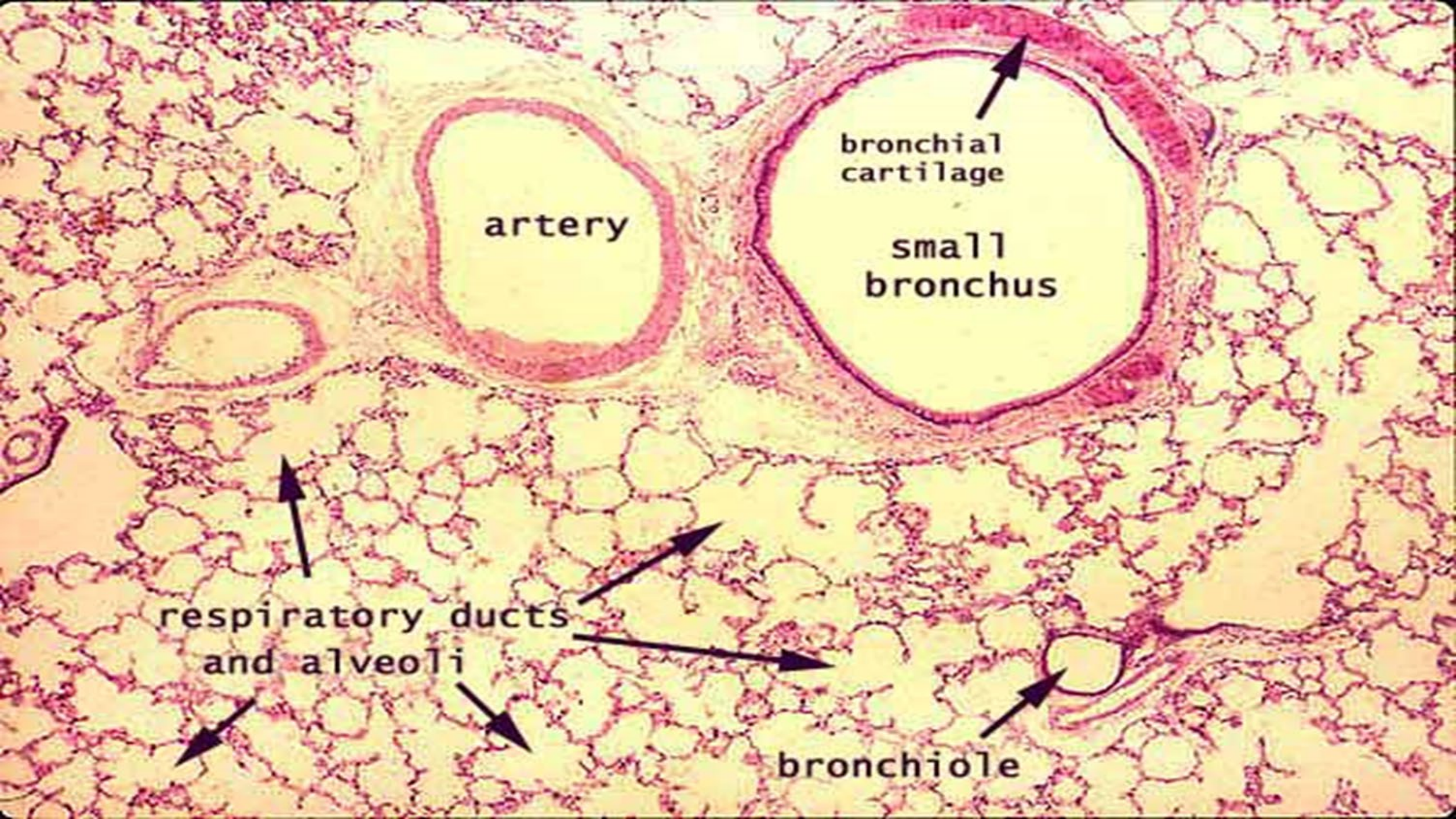


(b)



Scanning EM of interalveolar septum in lung





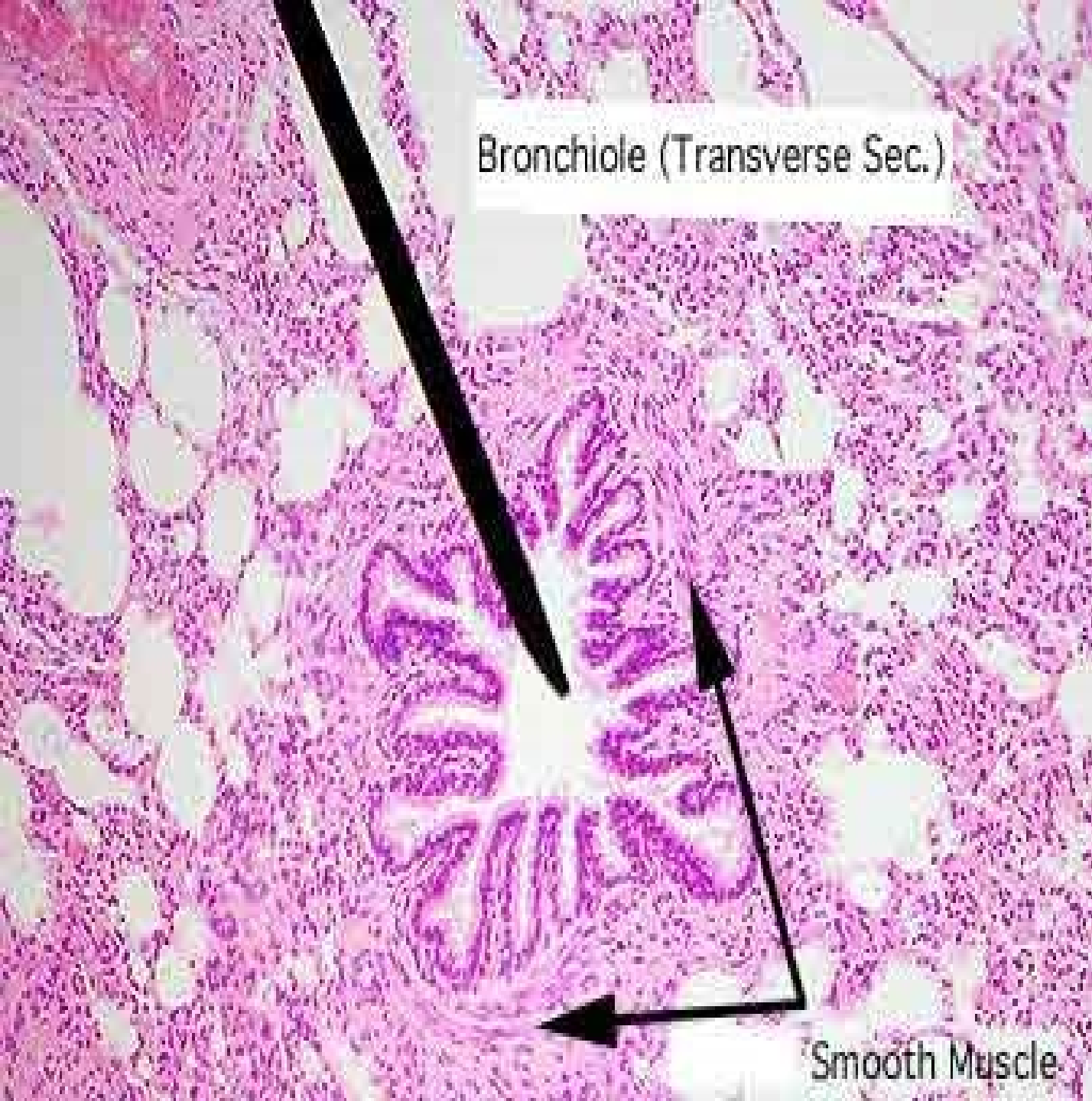
artery

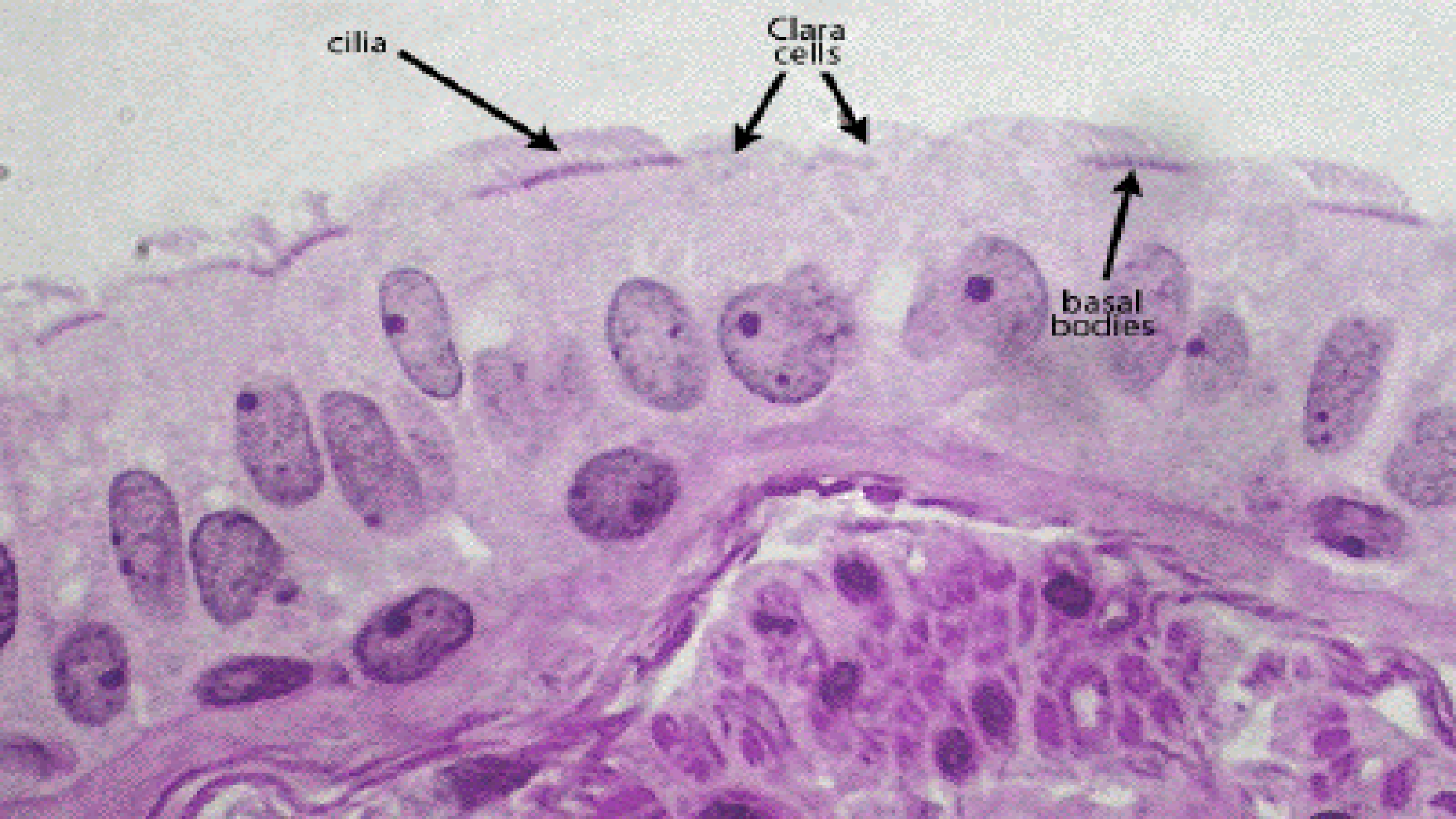
bronchial
cartilage

small
bronchus

respiratory ducts
and alveoli

bronchiole



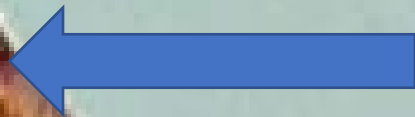
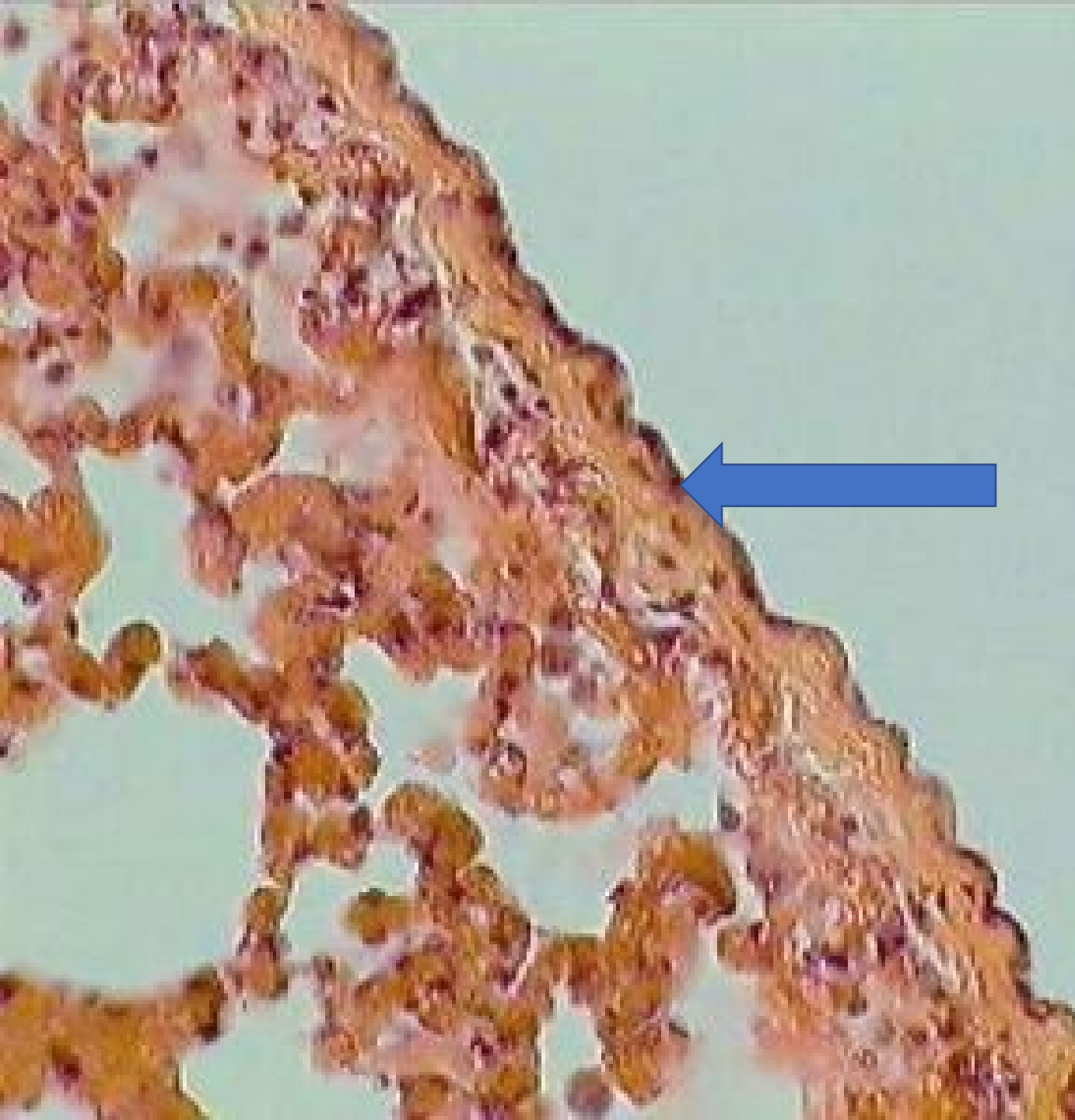


cilia

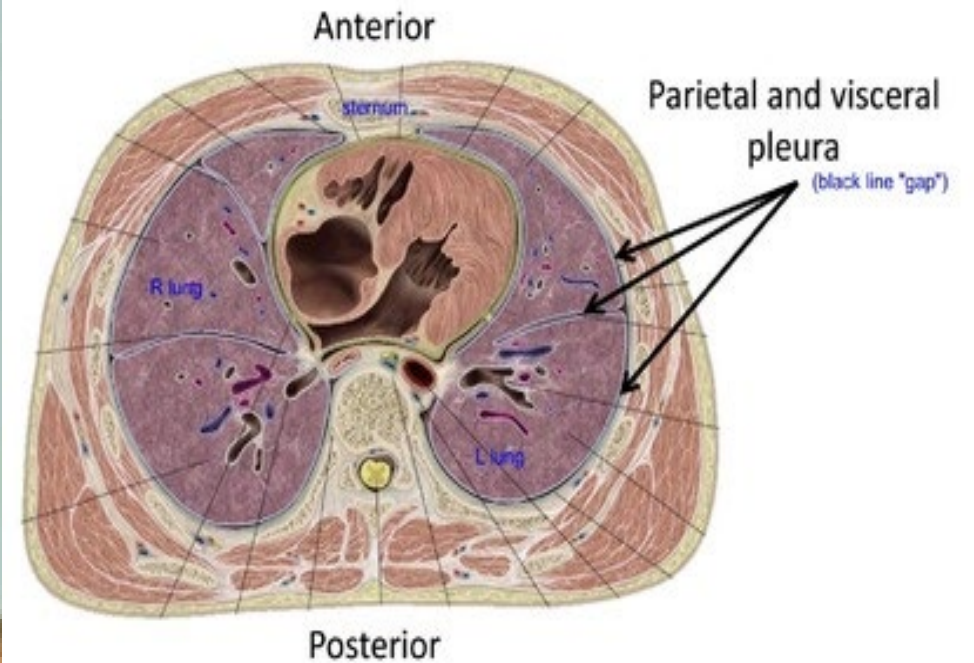
Clara
cells

basal
bodies

Pleura



Visceral pleura



Structure ¹	Anatomic Description	Wall Support	Epithelial Lining	Function
Larynx	Somewhat cylindrical structure between pharynx and trachea	Nine pieces of cartilage; supported by ligaments and skeletal muscle	Nonkeratinized stratified squamous epithelium superior to vocal folds; pseudostratified ciliated columnar epithelium inferior to vocal folds	Conducts air; prevents ingested material from entering trachea; produces sound; assists in increasing pressure in abdominal cavity; participates in both sneeze and cough reflex
Trachea	Flexible, semirigid, tubular organ connecting larynx to main bronchi	C-shaped cartilage rings keep trachea patent (open)	Pseudostratified ciliated columnar epithelium	Conducts air
Bronchi	Largest airways of bronchial tree; consist of main, lobar, segmental, and smaller bronchi	Incomplete rings and irregular plates of cartilage; some smooth muscle	Larger bronchi lined by pseudostratified ciliated columnar epithelium; smaller bronchi lined by simple ciliated columnar epithelium	Conduct air
Bronchioles	Smaller conducting airways of bronchial tree; larger bronchioles branch into smaller bronchioles; terminal bronchioles are last part of conducting zone	No cartilage; proportionately greater amounts of smooth muscle in walls	Ranges from simple ciliated columnar epithelium (for largest bronchioles) to simple cuboidal epithelium (for smaller bronchioles)	Conduct air; smooth muscle in walls allows bronchoconstriction and bronchodilation
Respiratory bronchioles	First structures of respiratory zone	No cartilage; smooth muscle is scarce in walls	Simple cuboidal epithelium	Gas exchange
Alveolar ducts	Small airways that branch off respiratory bronchioles; multiple alveoli found along walls of alveolar duct	No cartilage; no smooth muscle	Simple squamous epithelium	Gas exchange
Alveoli	Small air sacs	No cartilage; no smooth muscle	Simple squamous epithelium	Gas exchange

1. Structures are listed in the order that air passes through them during inspiration.

