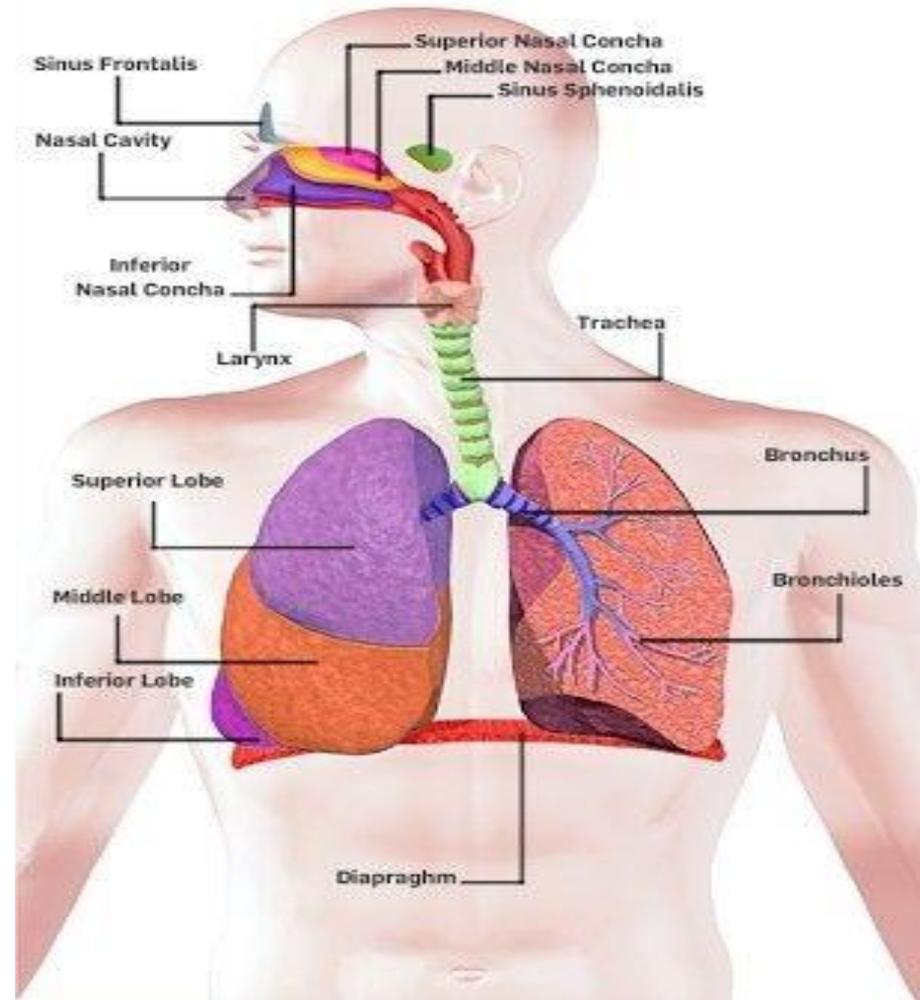


Histology of Respiratory System

Function

- ❑ Inspiration of air, gas exchange, expiration of CO₂
- ❑ Chemoreceptors of sense of smell
- ❑ Phonation



The parts of the respiratory system

The respiratory system is divided into two parts:

Upper respiratory tract:

This includes :

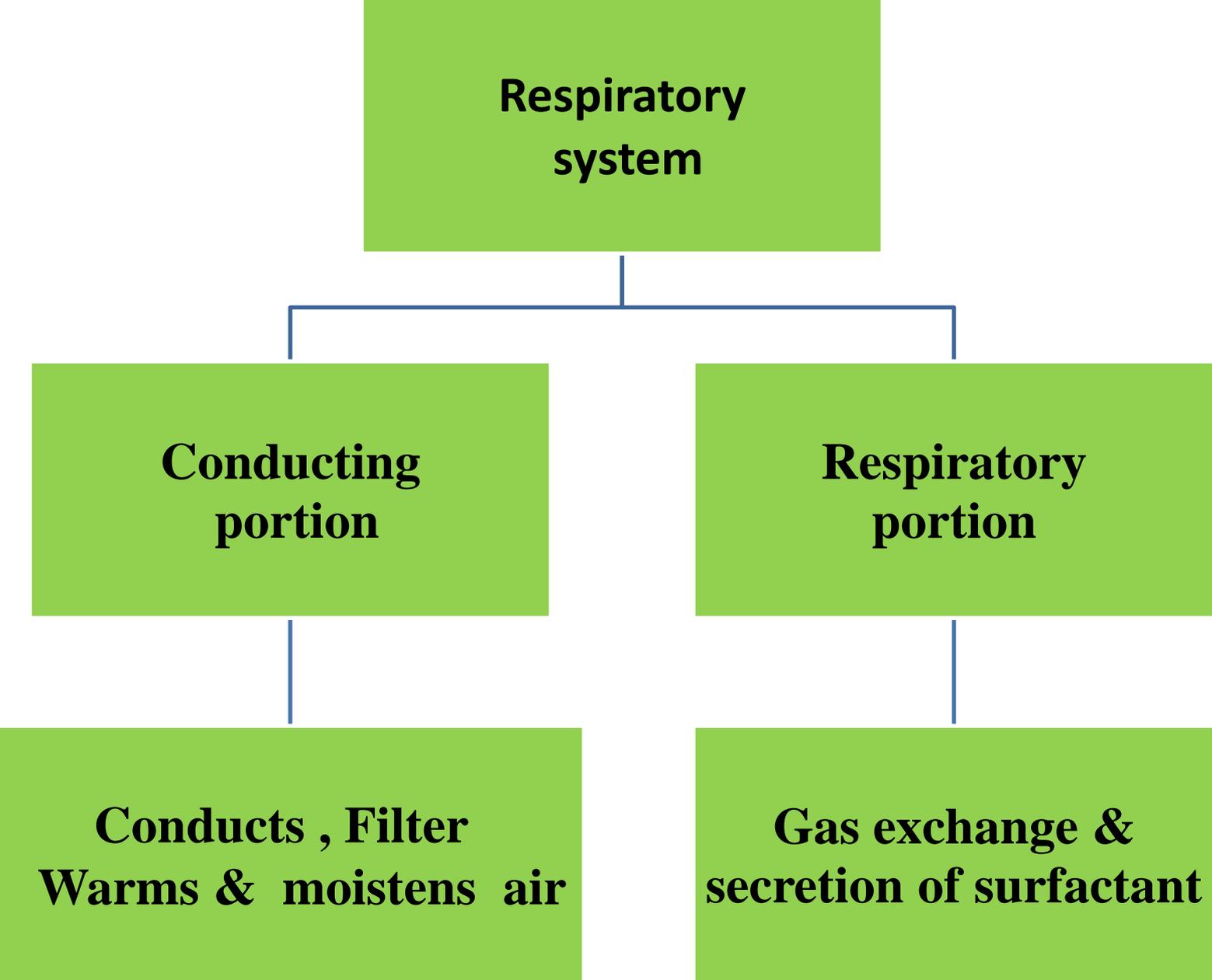
- Nose. mouth,
- and the beginning of the trachea.

Lower respiratory tract

It includes the trachea, the bronchi, broncheoli and the lungs.

- The trachea** :It connecting the throat to the bronchi.
- The bronchi** : It divides into two bronchi (tubes).
- The broncheoli** :the bronchi branches off into smaller tubes called broncheoli which end in the pulmonary alveolus.
- The Lungs**: The structure of the lungs includes the bronchial tree – air tubes branching off from the bronchi into smaller and smaller air tubes, each one ending in a pulmonary alveolus.

Respiratory system



```
graph TD; A[Respiratory system] --> B[Conducting portion]; A --> C[Respiratory portion]; B --> D["Conducts , Filter  
Warms & moistens air"]; C --> E["Gas exchange &  
secretion of surfactant"]
```

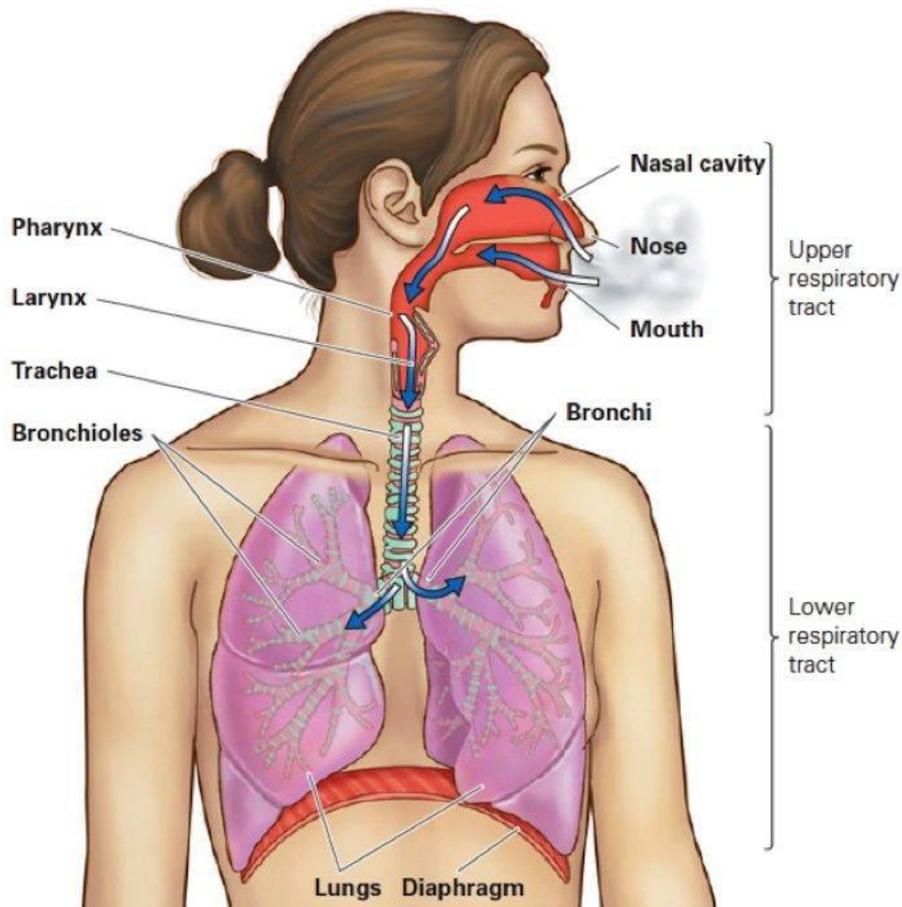
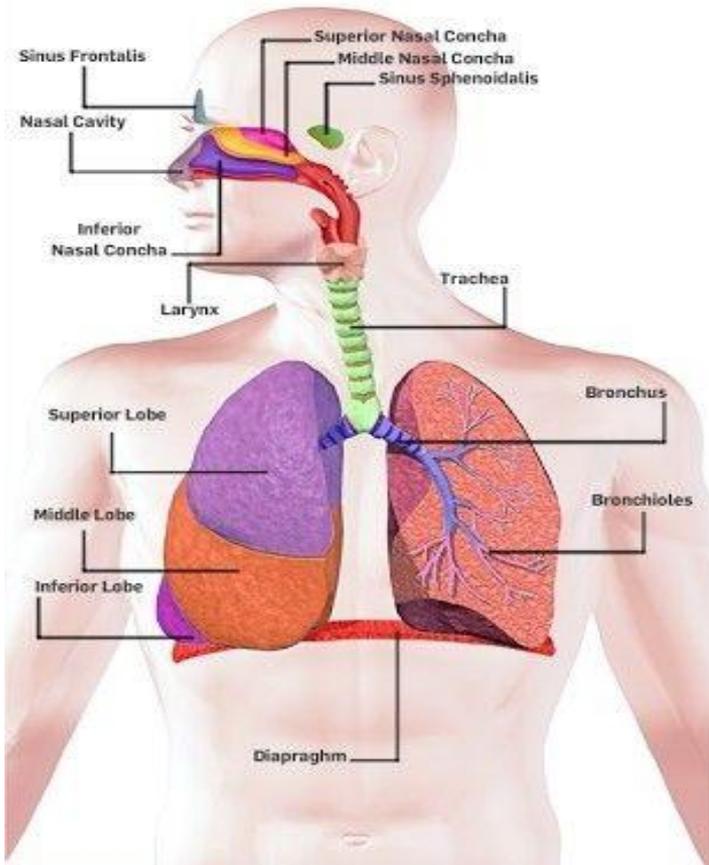
The diagram is a hierarchical flowchart. At the top is a green box labeled 'Respiratory system'. A horizontal line below it branches into two vertical lines leading to two more green boxes: 'Conducting portion' on the left and 'Respiratory portion' on the right. Below 'Conducting portion' is a final green box with two lines of text: 'Conducts , Filter' and 'Warms & moistens air'. Below 'Respiratory portion' is a final green box with two lines of text: 'Gas exchange &' and 'secretion of surfactant'. All boxes are green with black text, and lines are blue.

Conducting portion

**Conducts , Filter
Warms & moistens air**

Respiratory portion

**Gas exchange &
secretion of surfactant**



The conducting portion includes:

- Nasal cavity
- pharynx
- Larynx
- Trachea
- Primary bronchi (RT +LT)
- 2ry , 3ry bronchi
- Bronchioles
- Terminal bronchioles

Function of conducting portion:

- Conduction of air
- Conditioning of air

Structure / Function of conducting portion:

1- Conduction of air:

- Cartilages to prevent collapse,
- Elastic & smooth ms. fibers for flexibility

2- Conditioning of air:

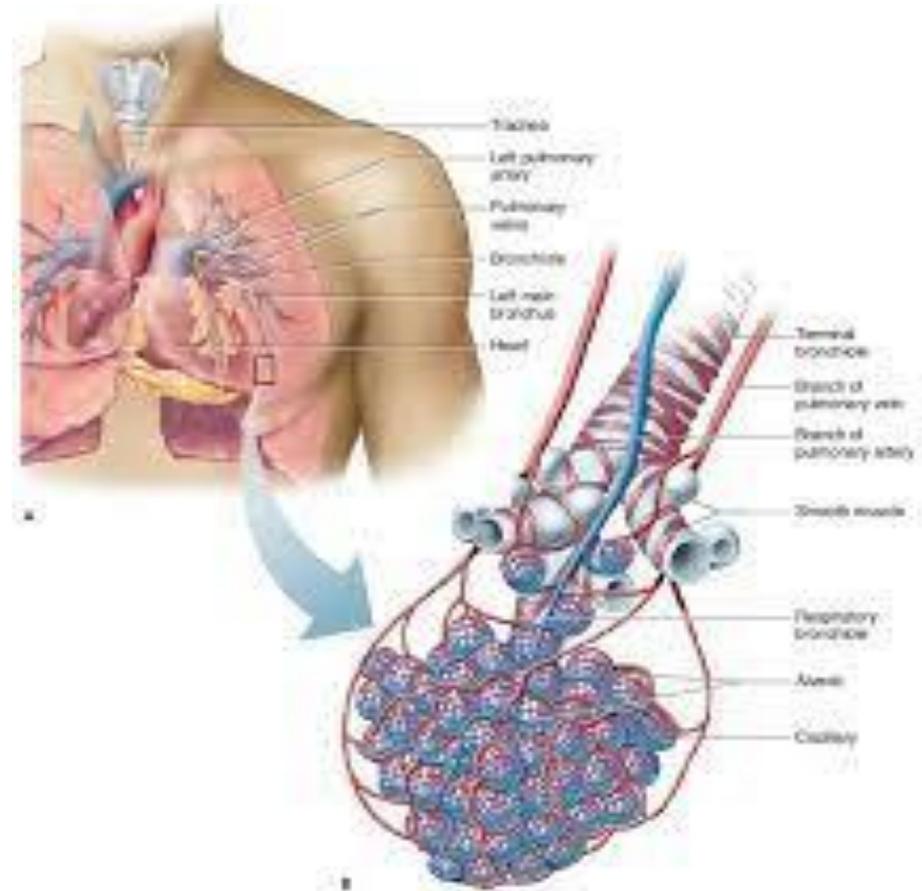
- Nasal hairs: clean & trap large particles
- Capillaries: adjust temperature
- Respiratory mucosa: adjust moisture & filters air

The respiratory portion includes:

- Respiratory bronchioles
- Alveolar ducts
- Alveolar sacs
- Alveoli

Function of respiratory portion:

O₂/CO₂ exchange take place between blood & inspired air



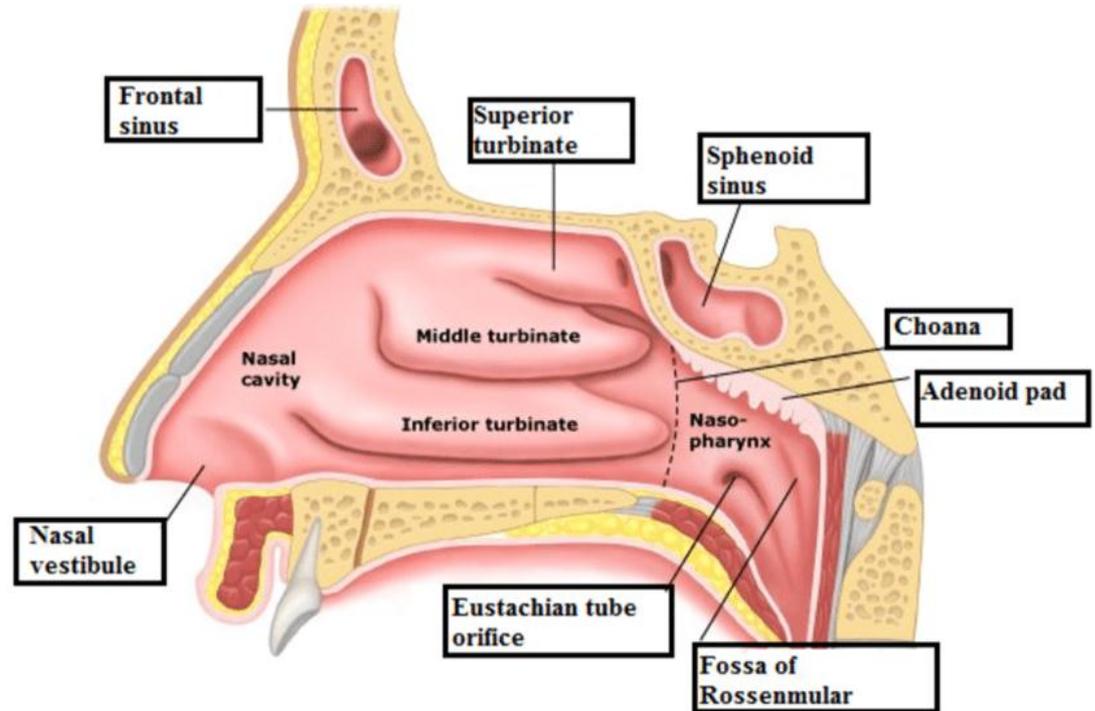
Nasal cavities

Consists of:

- ❑ Vestibule
- ❑ Respiratory area
- ❑ Olfactory area

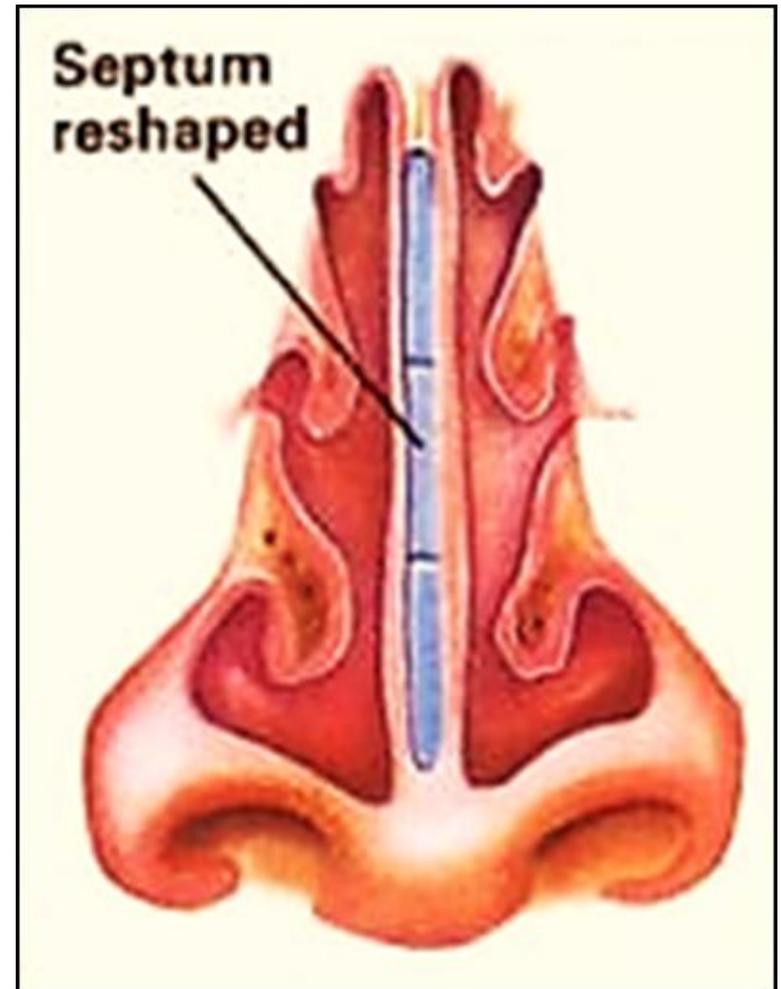
Vestibule:

- Is the anterior part
- Formed of skin + sebaceous gland + hair
- Lined with keratinizes stratified squamous epithelium



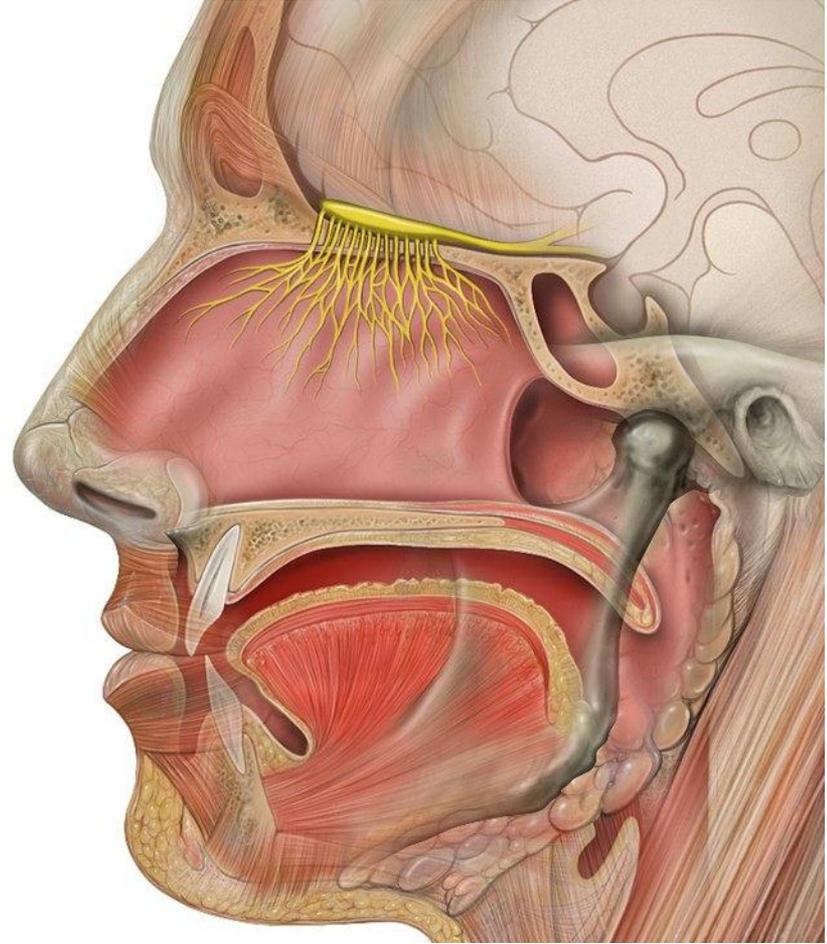
The Nasal Cavities

- 2 cavities separated by nasal septum
- Their lateral walls contain 3 bony projections (conchae) superior, middle, inferior
- The conchae increase the surface area for better conditioning of the inspired air
- Superior one covered with **Olfactory epithelium**
- Middle & inferior covered with **Respiratory epithelium**= a **ciliated pseudostratified columnar epithelium**



The olfactory epithelium

- ❑ Site : Covers the roof of nasal cavities & superior conchae.
- ❑ Contains chemoreceptors of smell
- ❑ 3 cell types are present:
 1. Olfactory receptor neurons
 2. Supporting (sustentacular) cells
 3. Basal cells
- The olfactory mucosa consists of:
 - 1- The epithelium rests on
 - 2- lamina propria which contains:
 - ✓ Bowman's glands, secrete **serous** fluid → surface
 - ✓ BV & olfactory nerve fibers



The olfactory epithelium

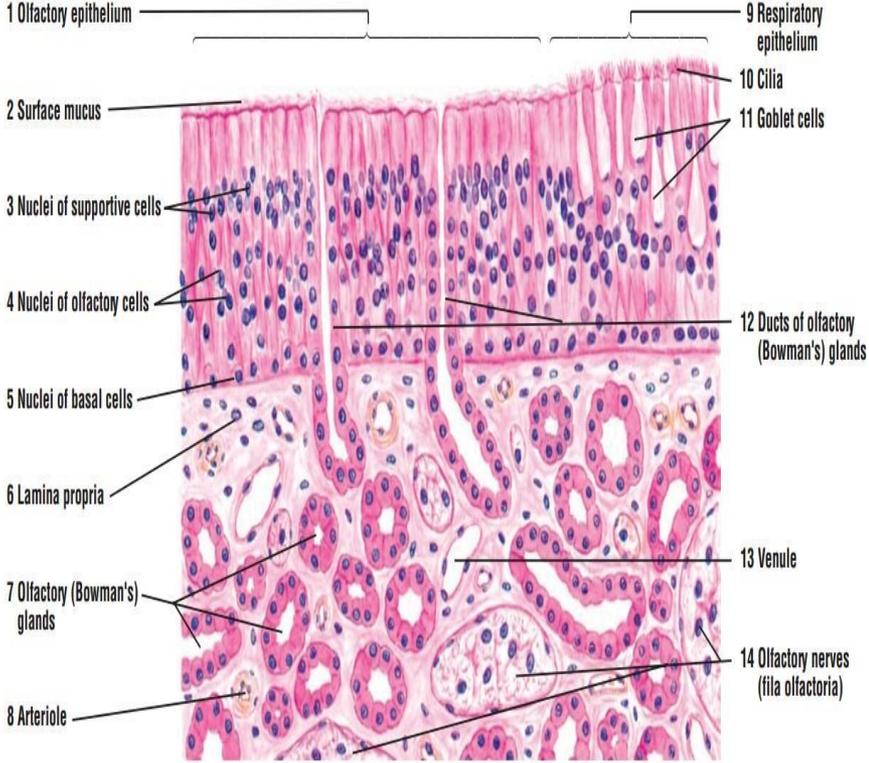
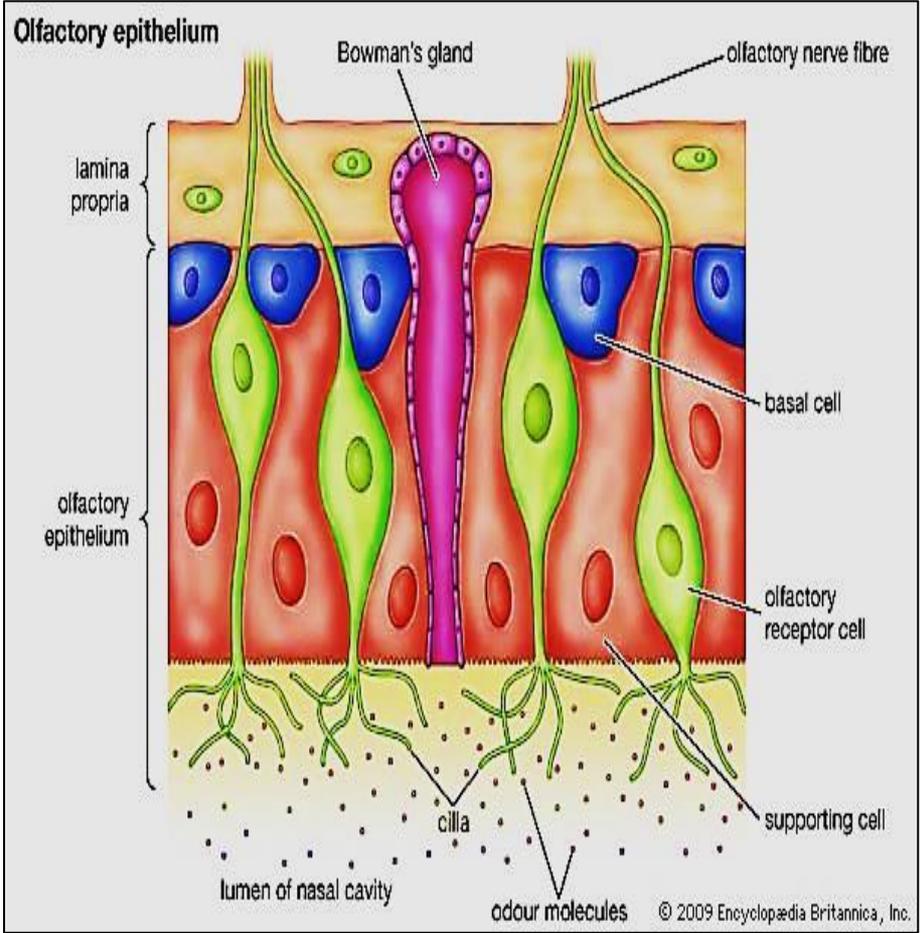


FIGURE 15.2 ■ Olfactory mucosa: details of a transitional area. Stain: hematoxylin and eosin. High magnification.



The respiratory epithelium

The respiratory epithelium is a tissue that lines the respiratory system.

❑ **Pseudo-stratified columnar ciliated + goblet cells**

Role of the respiratory epithelium are:

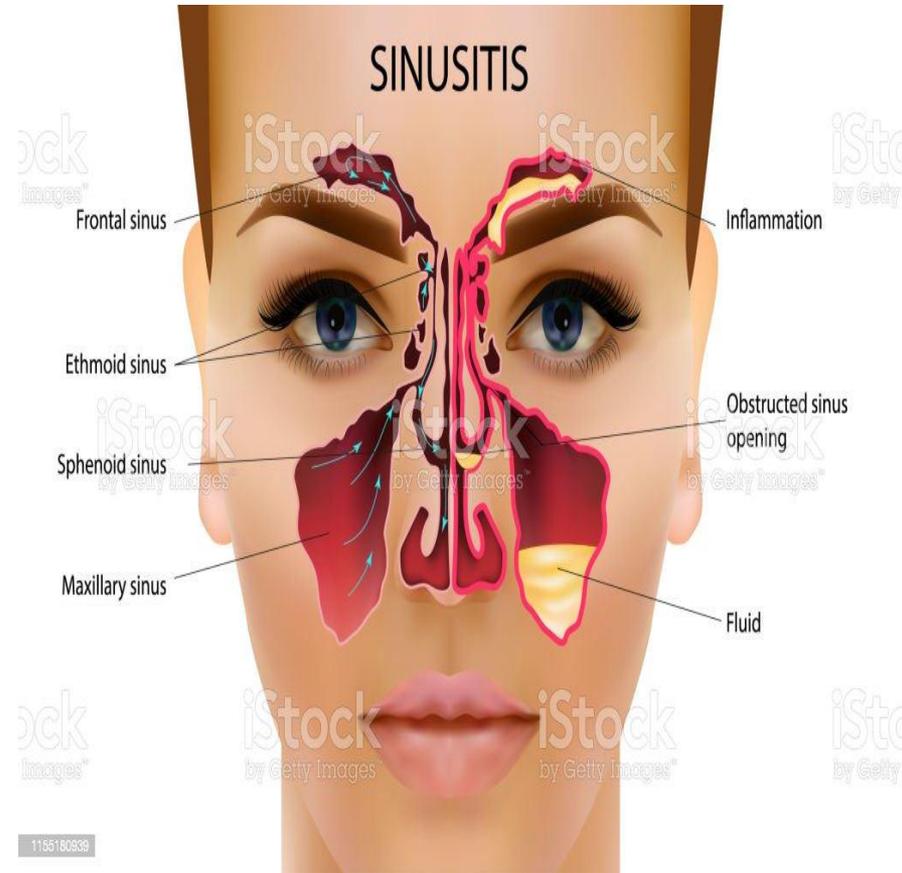
- 1- It serves as a protective barrier and,
- 2- It also provides moisture.

The olfactory epithelium:

➤ **Specialized Pseudo stratified columnar + chemoreceptors & NO goblet cells**

Paranasal sinuses

- ❑ Frontal, ethmoidal, sphenoidal maxillary
- ❑ Skull cavities open in nasal cavity
- ❑ Lined with **thin** respiratory epithelium with **few goblet** cells which is **very adherent to the periosteum**
- ❑ Inflammation = sinusitis -----
---severe pain



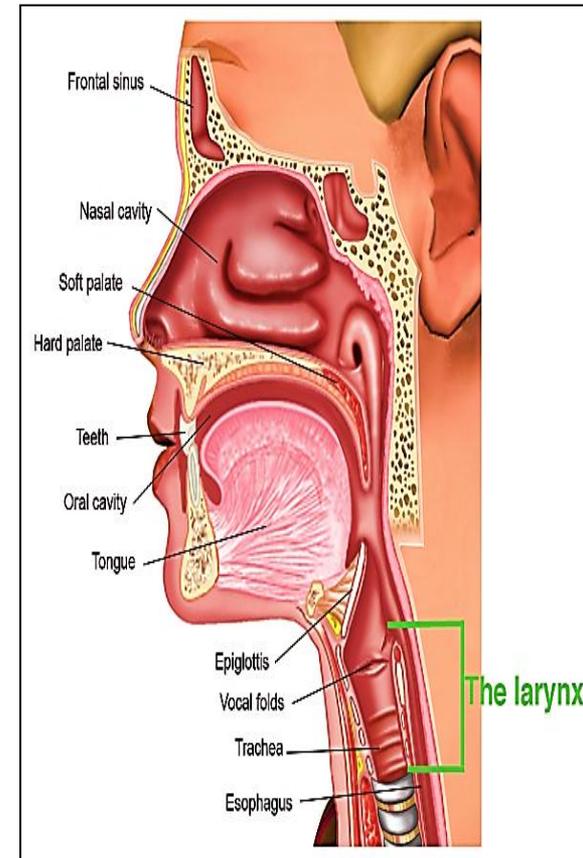
Larynx:

- At the beginning of trachea
- Its beginning is guarded by epiglottis

Has 2 functions:

- ✓ production of voice (vocal cords)
- ✓ Prevent food from entering the trachea (epiglottis has **elastic** cartilage in its lamina propria)

- Lined with respiratory epithelium

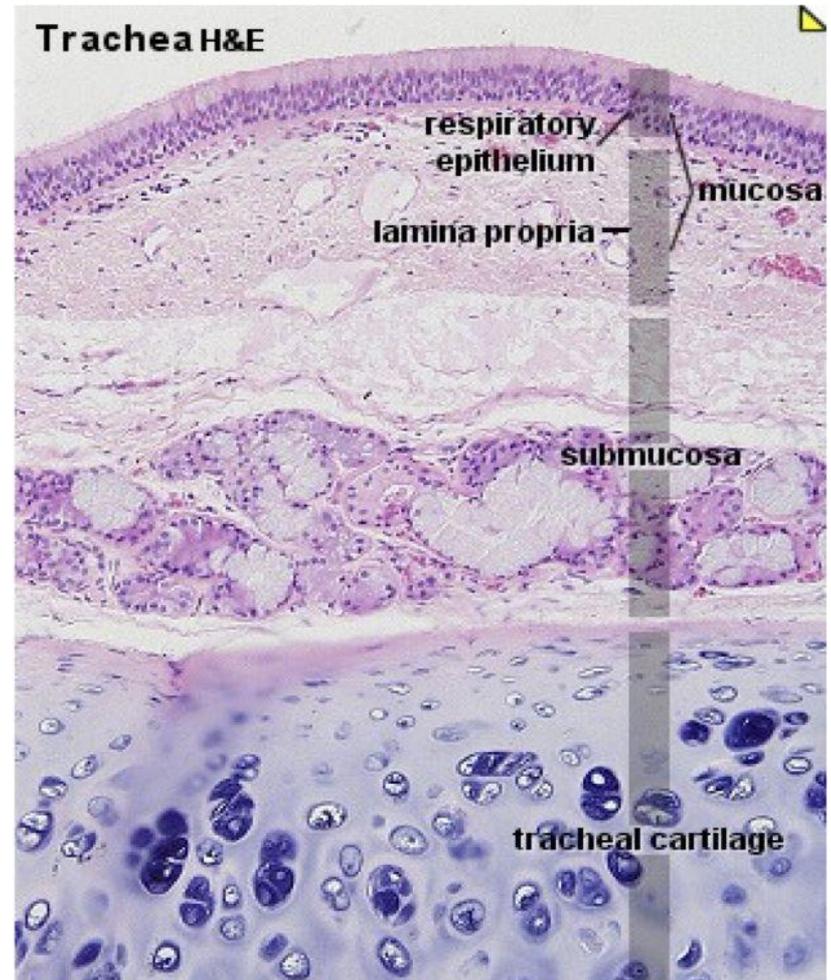


Trachea

- Tube extends from larynx & ends by dividing into 2 bronchi
- Kept open by about 20 C- shaped Cartilage rings (hyaline cartilage)

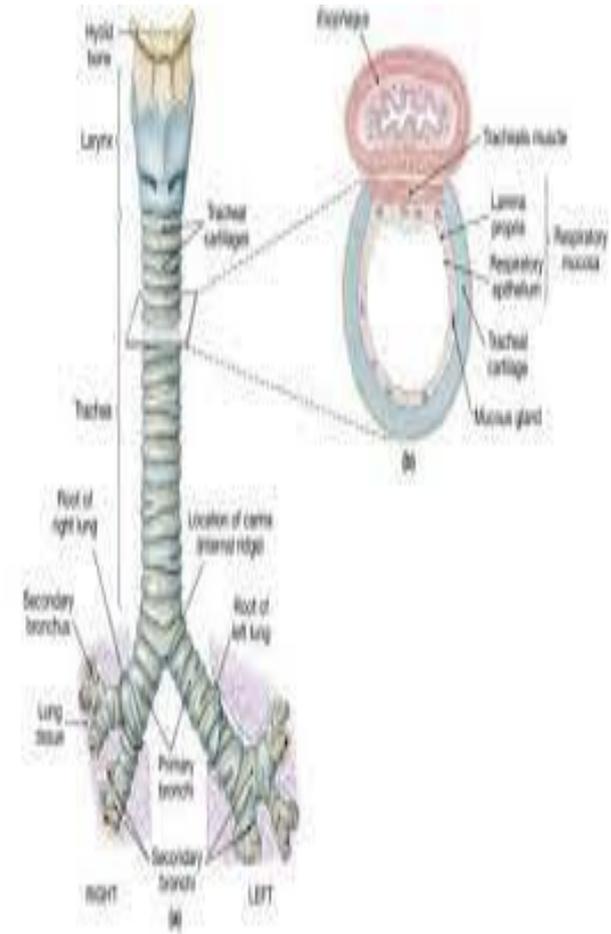
Its wall is formed of 4 layers:

1. Mucosa
2. Submucosa
3. Hyaline cartilage
4. adventitia

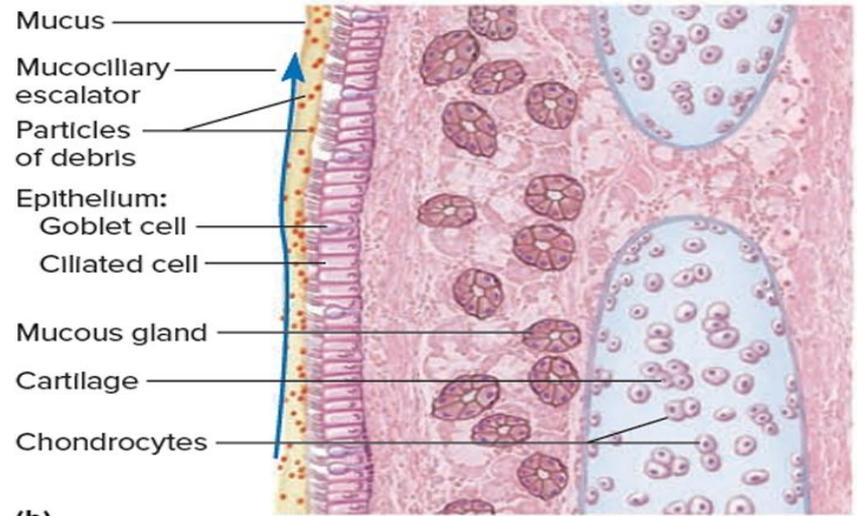
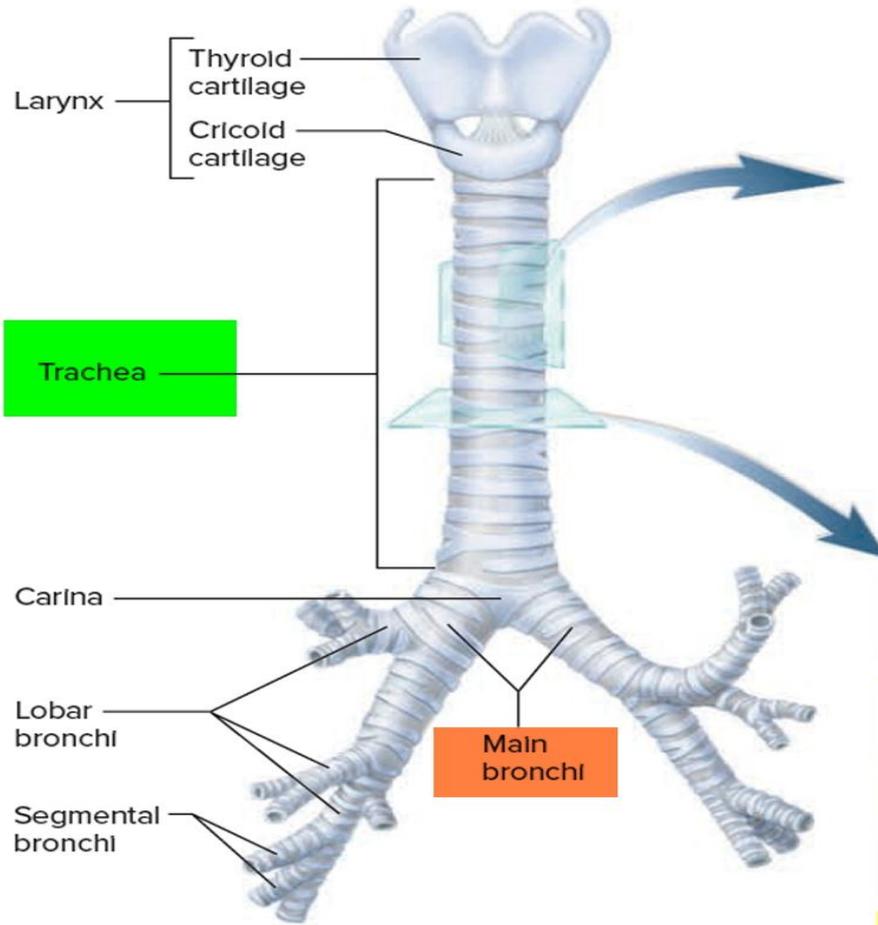


Trachea:

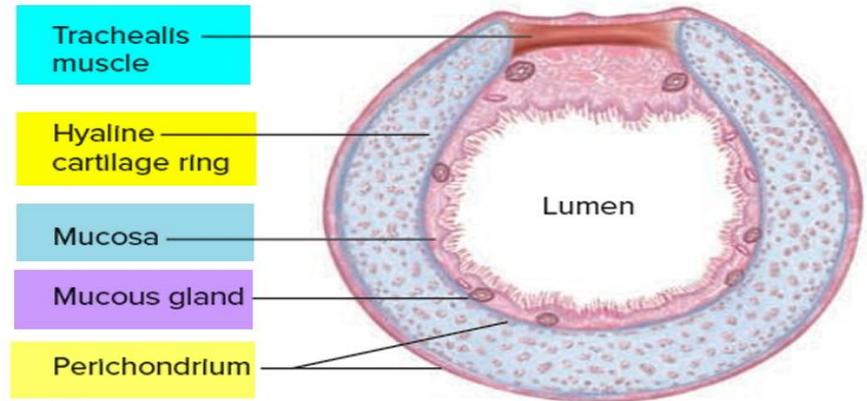
- **Mucosa**: respiratory epithelium + lamina propria
- **Submucosa**: loose CT. contain tracheal glands (mucus gland)
- **Cartilage layer**: C- shaped cartilage rings, the gap between cartilage ends connected by elastic ligament & Trachialis ms (smooth ms)
- **Adventitia**: loose CT



Trachea



(b)



(c)

(a)

Bronchial tree

- ✓ Primary (Extra pulmonary) bronchi
- ✓ Secondary (Intra-pulmonary) bronchi
- ✓ Bronchioles
- ✓ Terminal bronchioles
- **1ry bronchi**: RT & LF → similar to trachea
(but cartilage is **complete ring**)
- **2ry bronchi**: within the lung → divide into 3ry bronchi
Its wall is formed of 4 layers (**NO submucosa**)
 - Mucosa
 - Musculosa
 - Cartilage plates
 - Adventitia

Structure of 2ry & 3ry bronchi

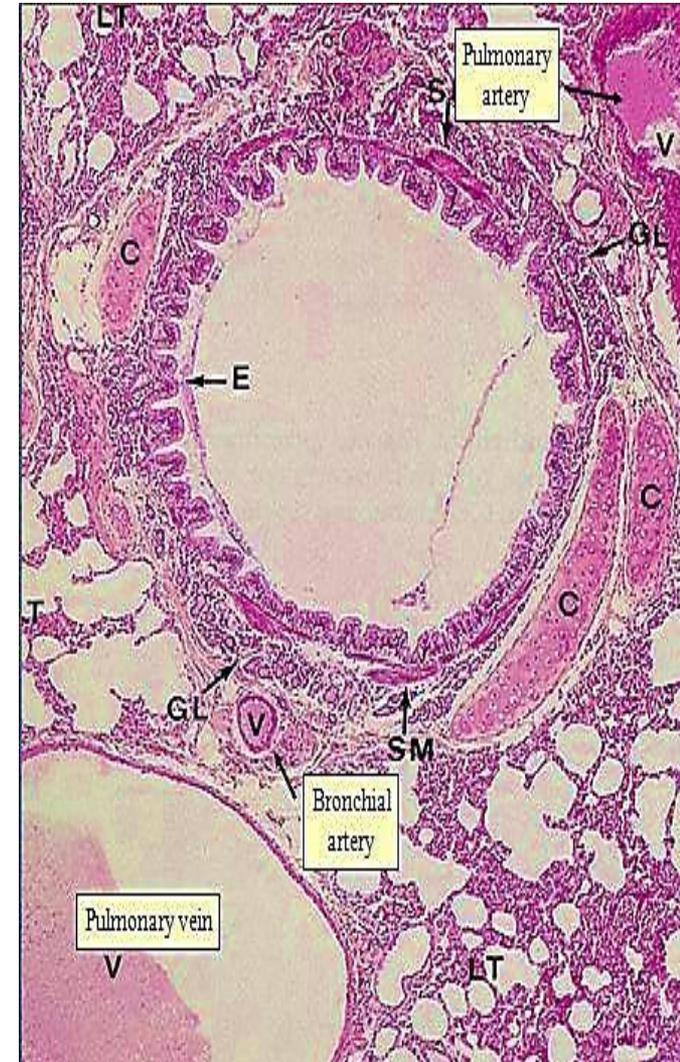
- **Mucosa:** respiratory epith + ↓ goblet cells
lamina propria has MALT

(mucosa associated lymphatic tissue)

- **Musculosa:** spiral layers of smooth ms. encircling the mucosa

- **Cartilage plates:**

- **adventitia:**



Structure of 2ry bronchi¹⁸

Bronchioles

- Small airways ↓ 0.5 mm
- Its wall has **No** (submucosa, cartilage, lymphatic nodules)
- Its wall formed of **3 layers**

Mucosa:

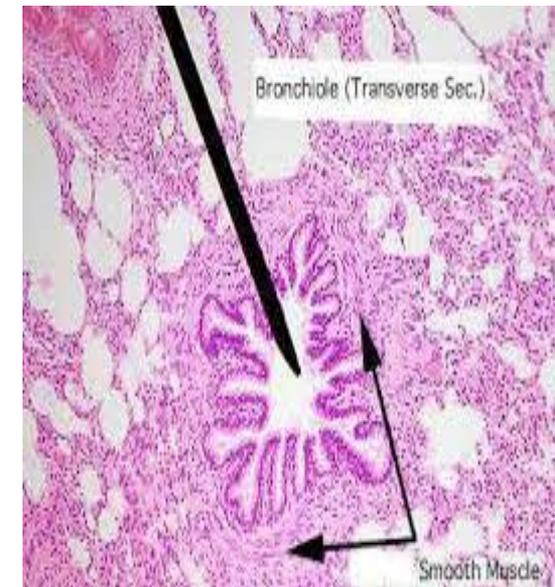
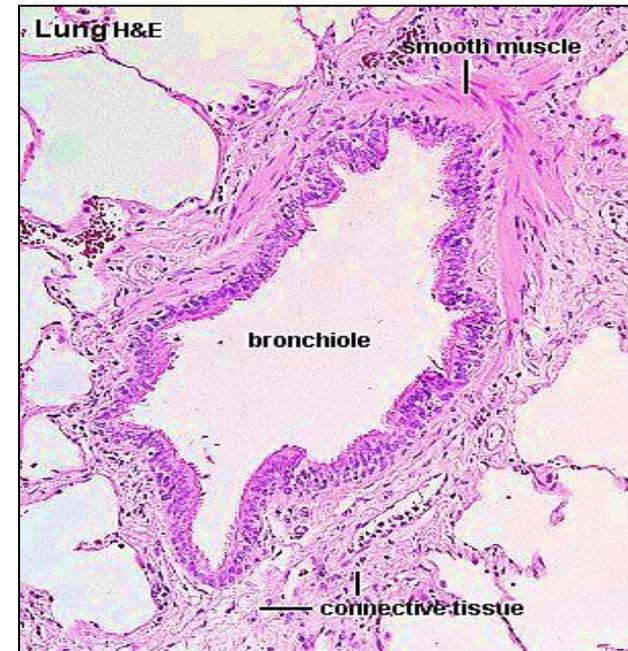
- Simple columnar ciliated + **Clara cells**

Musculosa:

complete layer of circularly arranged s.ms.

Adventitia:

CT layer



Clara cells

- ❑ Secretory cells with Dome shaped apex
- ❑ They also present in terminal bronchioles
- ❑ Protein Secreting cell prevent alveolar collapse

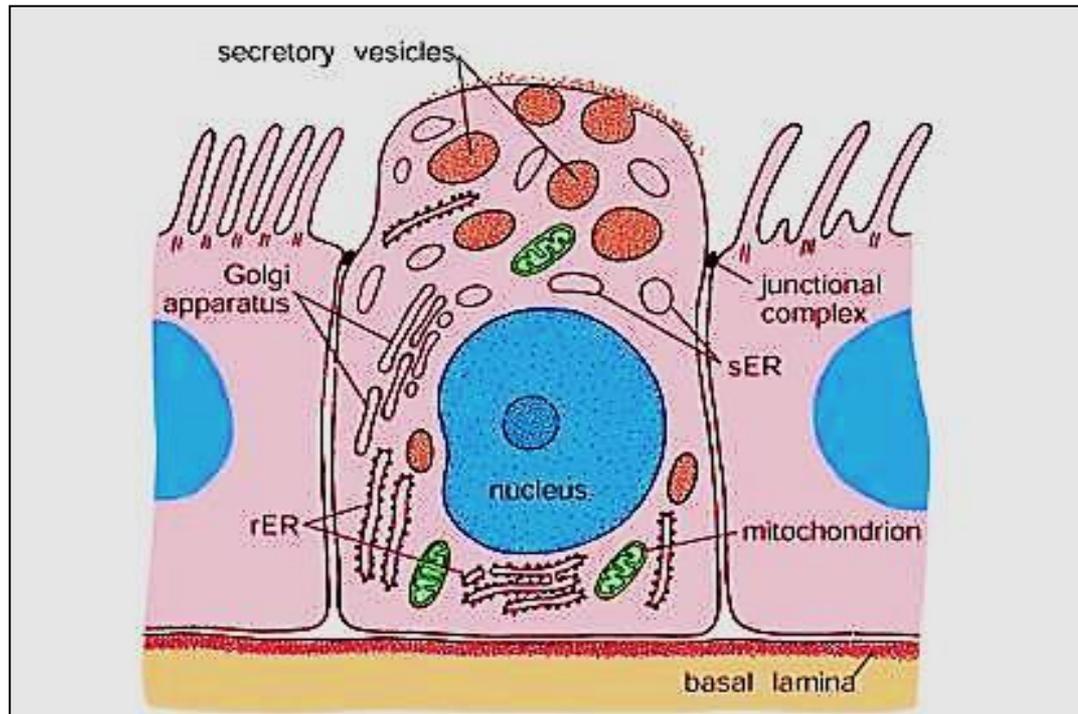
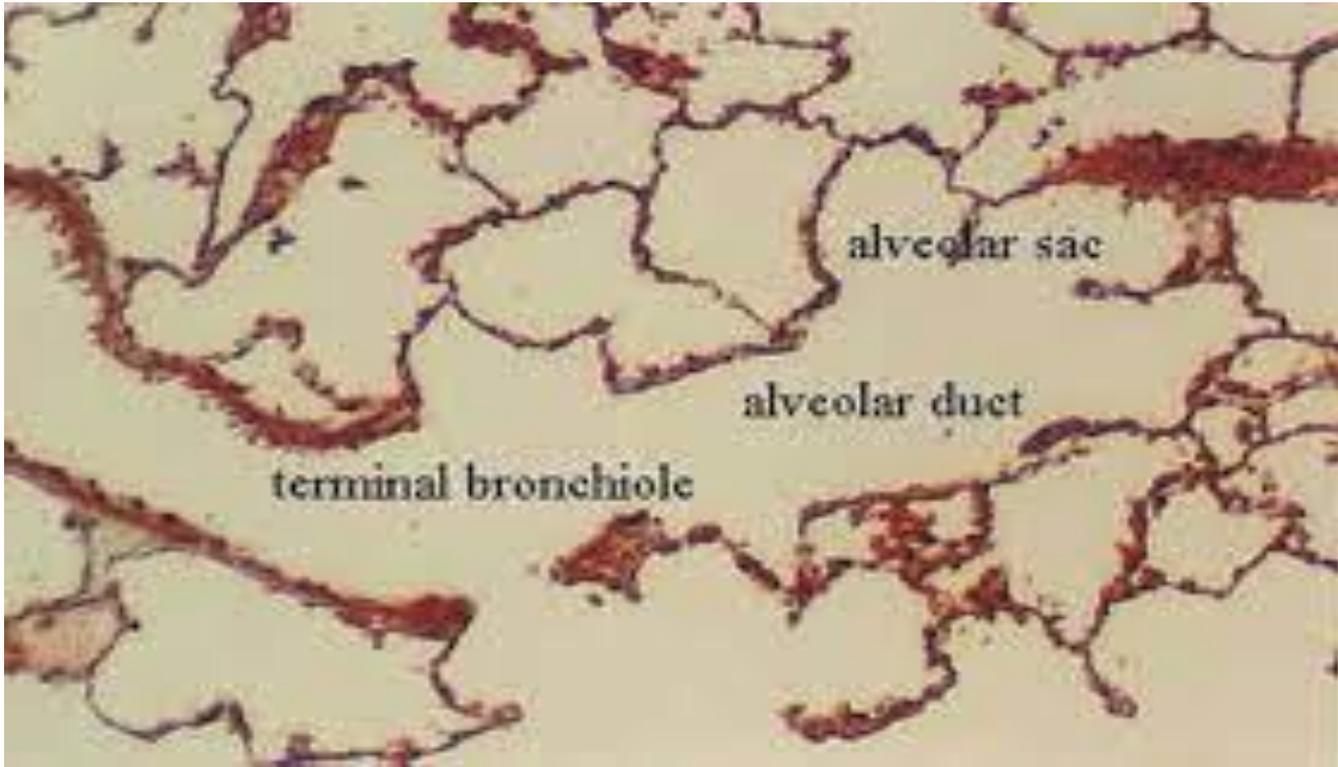


Figure 18.12. Diagram of a Clara cell between bronchiolar ciliated epithelial cells.

▪ **Terminal bronchioles:**



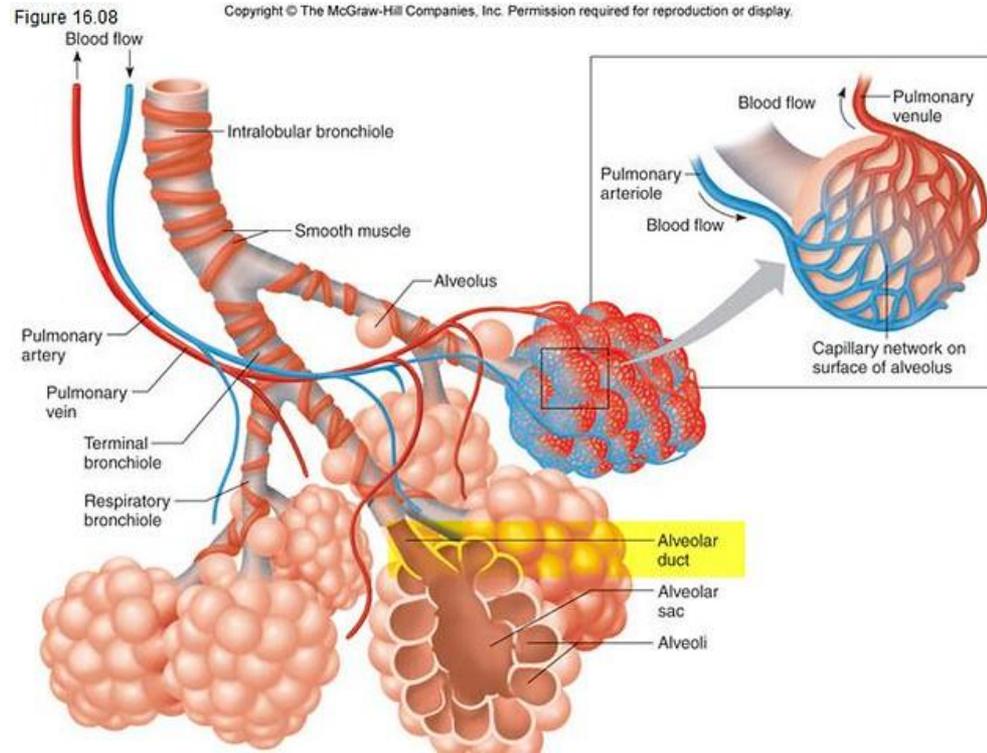
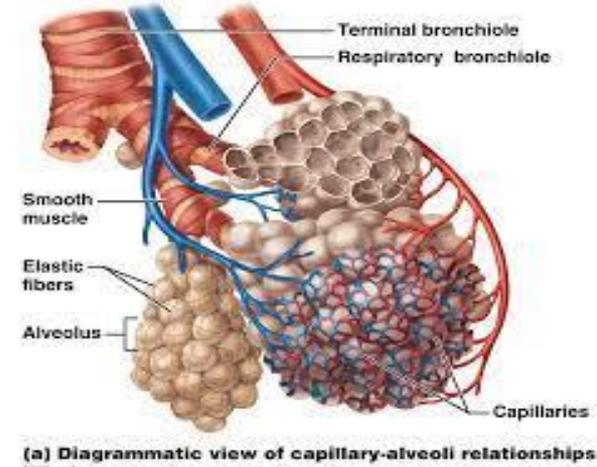
- The smallest & last part of conducting portion
- Lining epithelium: **simple cubical p. ciliated + Clara cells**

respiratory portion

- where gas exchange takes place

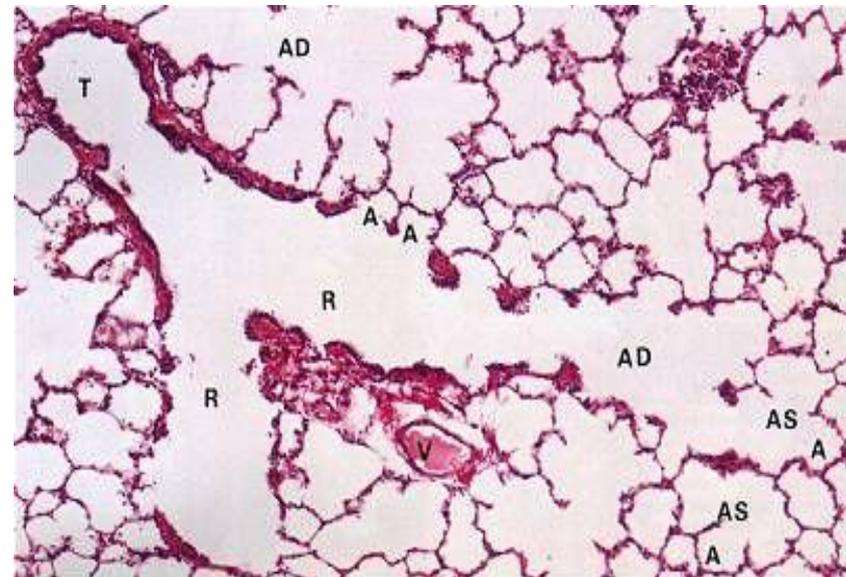
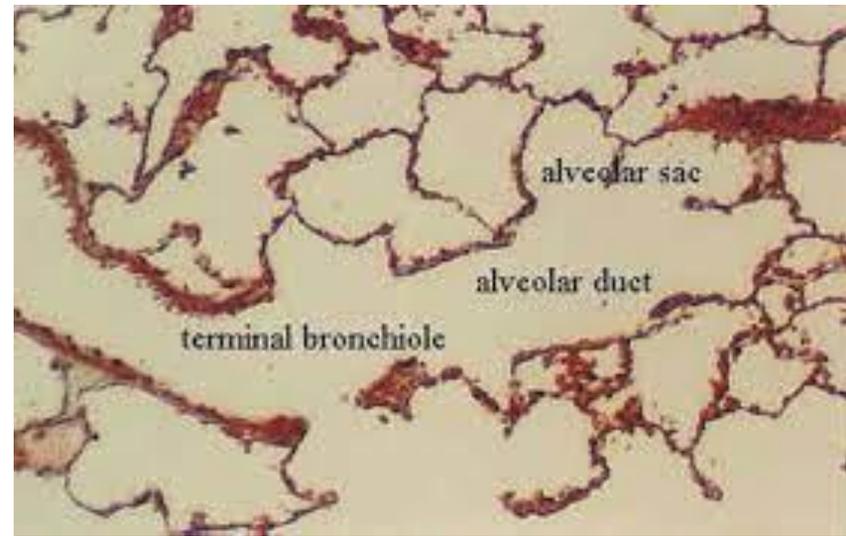
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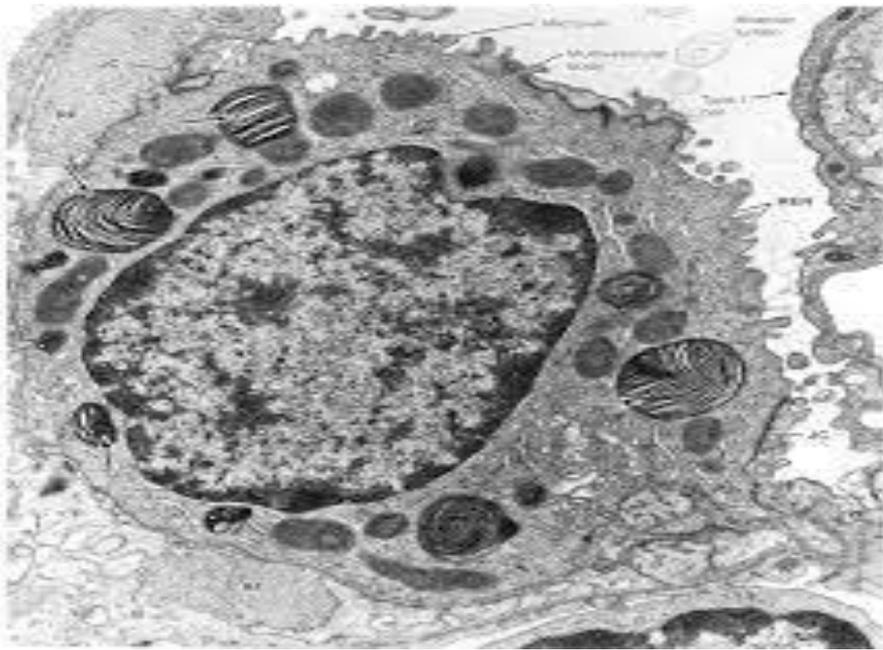
- ✓ Respiratory bronchioles
- ✓ Alveolar ducts
- ✓ Alveolar sacs
- ✓ Alveoli



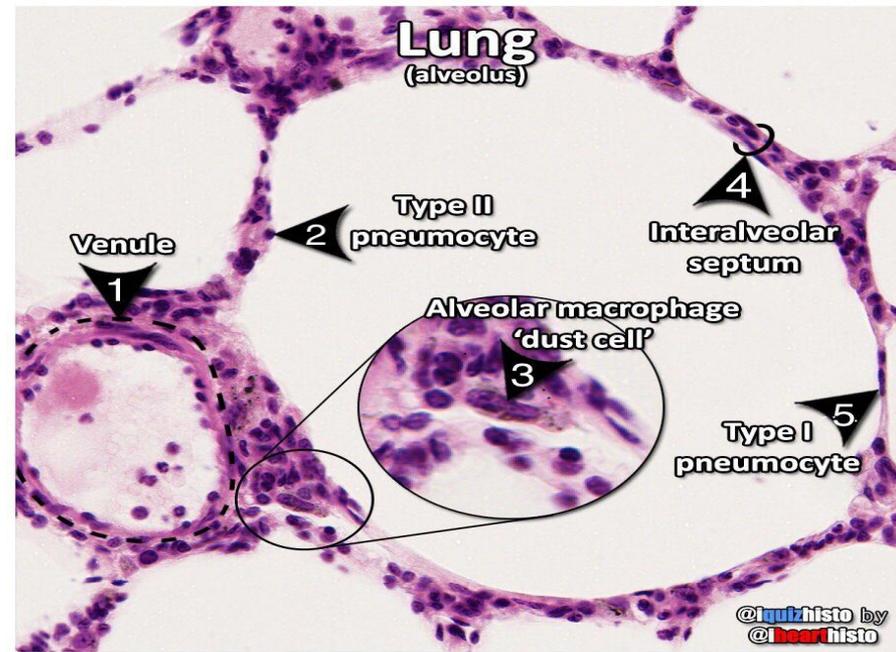
Alveoli

- Sac like structures
- Responsible for gas exchange
- They separated by thin septa called inter-alveolar septa
- Lined with 2 type of cells:
 - Type I pneumocyte
 - Type II pneumocyte





Type I pneumocytes



Type II pneumocytes

- Most cells (97%)
- Flat simple squamous cells e flat nuclei
- Function: Gas exchange

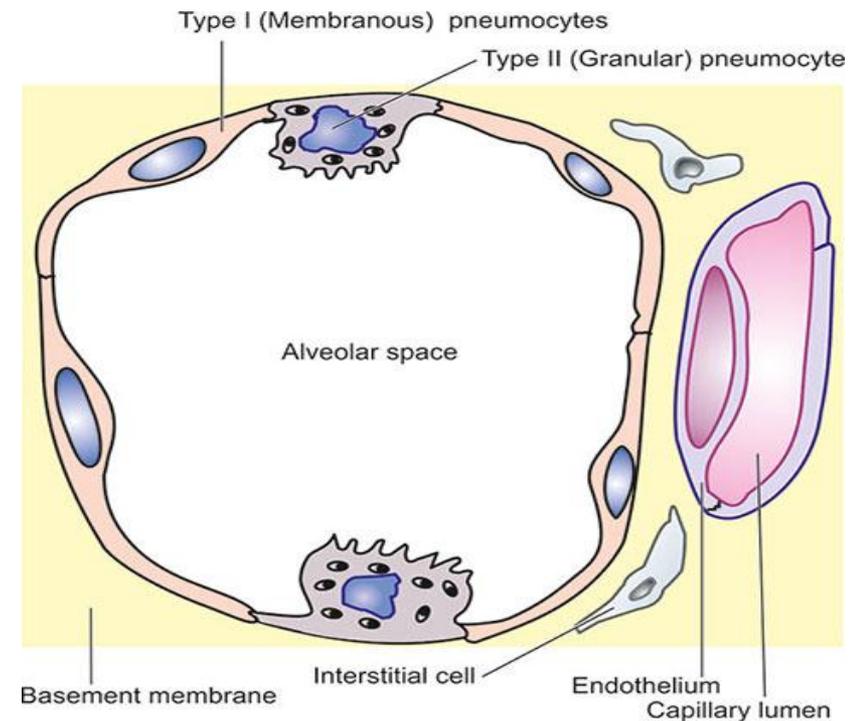
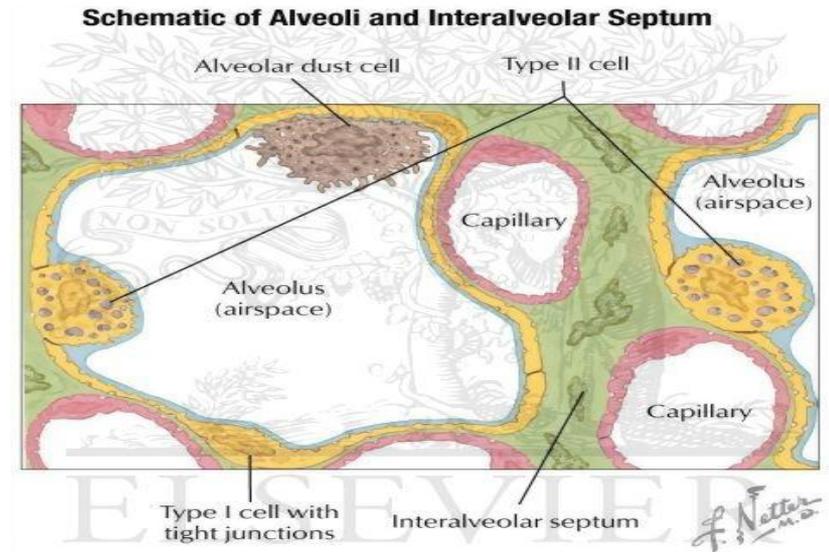
- 3%
- Cuboidal cells e central nuclei & foamy cytoplasm
- Function: Secrete surfactant + stem cells

Interalveolar septum

Def : The wall between two adjacent alveoli

Content :

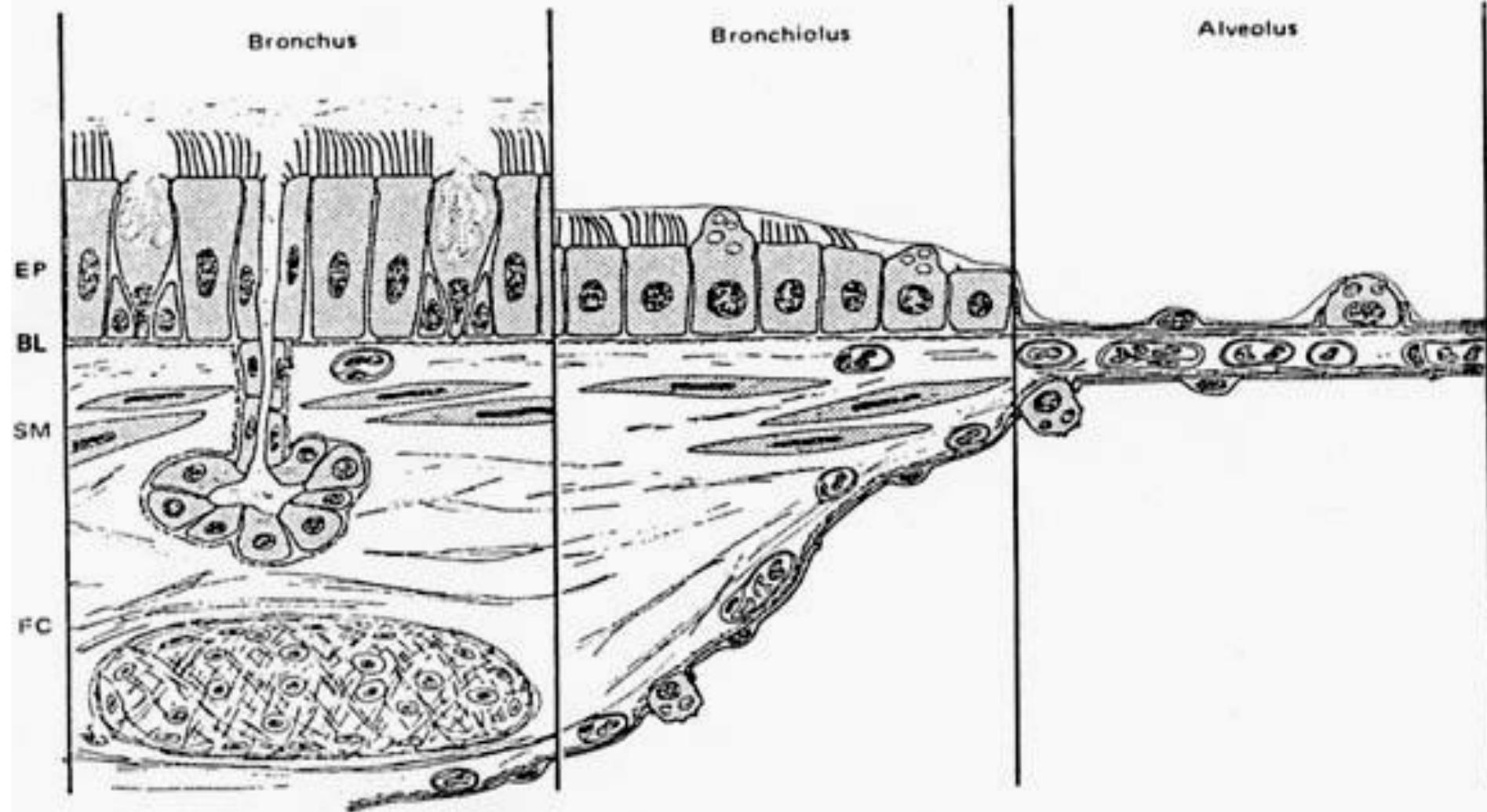
1. Pores
2. Capillary network
3. Elastic & reticular fibers
4. Cells (alveolar macrophages- fibroblast = interstitial cells



Epithelial transitions

The respiratory system provides beautiful examples of epithelial transitions.

- The pseudostratified ciliated columnar epithelium of the trachea and bronchi gives way to a simple columnar ciliated epithelium in the bronchioles and then to the simple squamous epithelium of the alveolar ducts and alveoli.
- The ciliated cells undergo a gradual reduction in height from trachea to terminal and respiratory bronchiole.



Change of airway wall structure at three principal levels in the lung. The epithelium (EP) gradually reduces from pseudostratified to cuboidal and then to squamous, but retains its organization as a mosaic of lining and secretory cells. The smooth-muscle layer (SM) disappears in the alveoli.