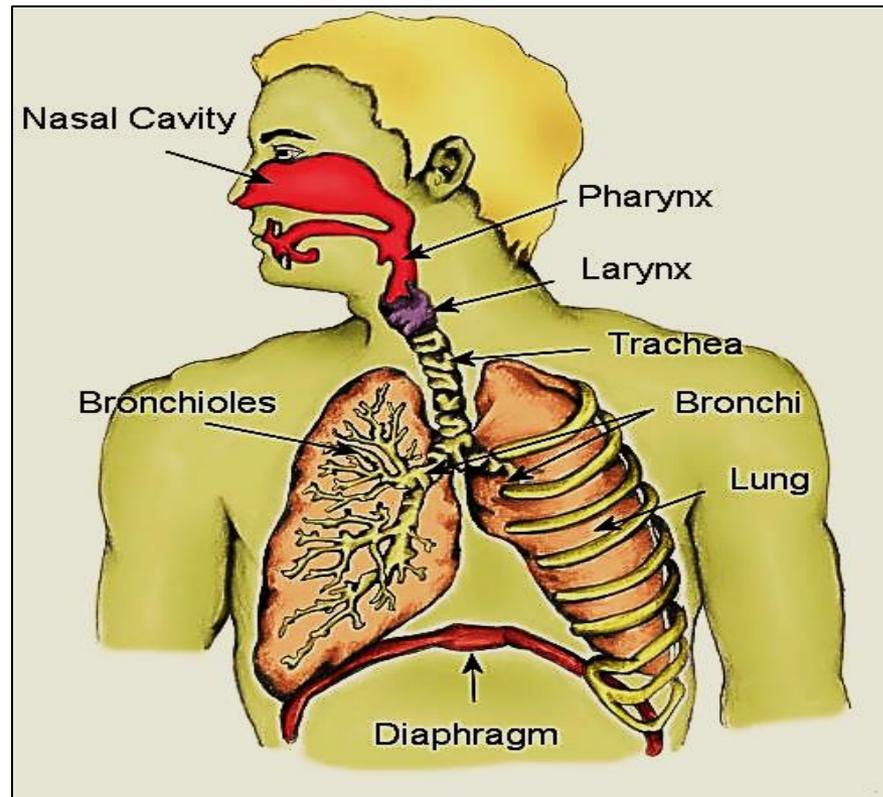


# Introduction to The respiratory system

## Medical students / First Year

### Professor Dr. Hala El-mazar



## By studying the respiratory system we learn about:

- structures involved in inspiration of air, gas exchange, expiration of CO<sub>2</sub>



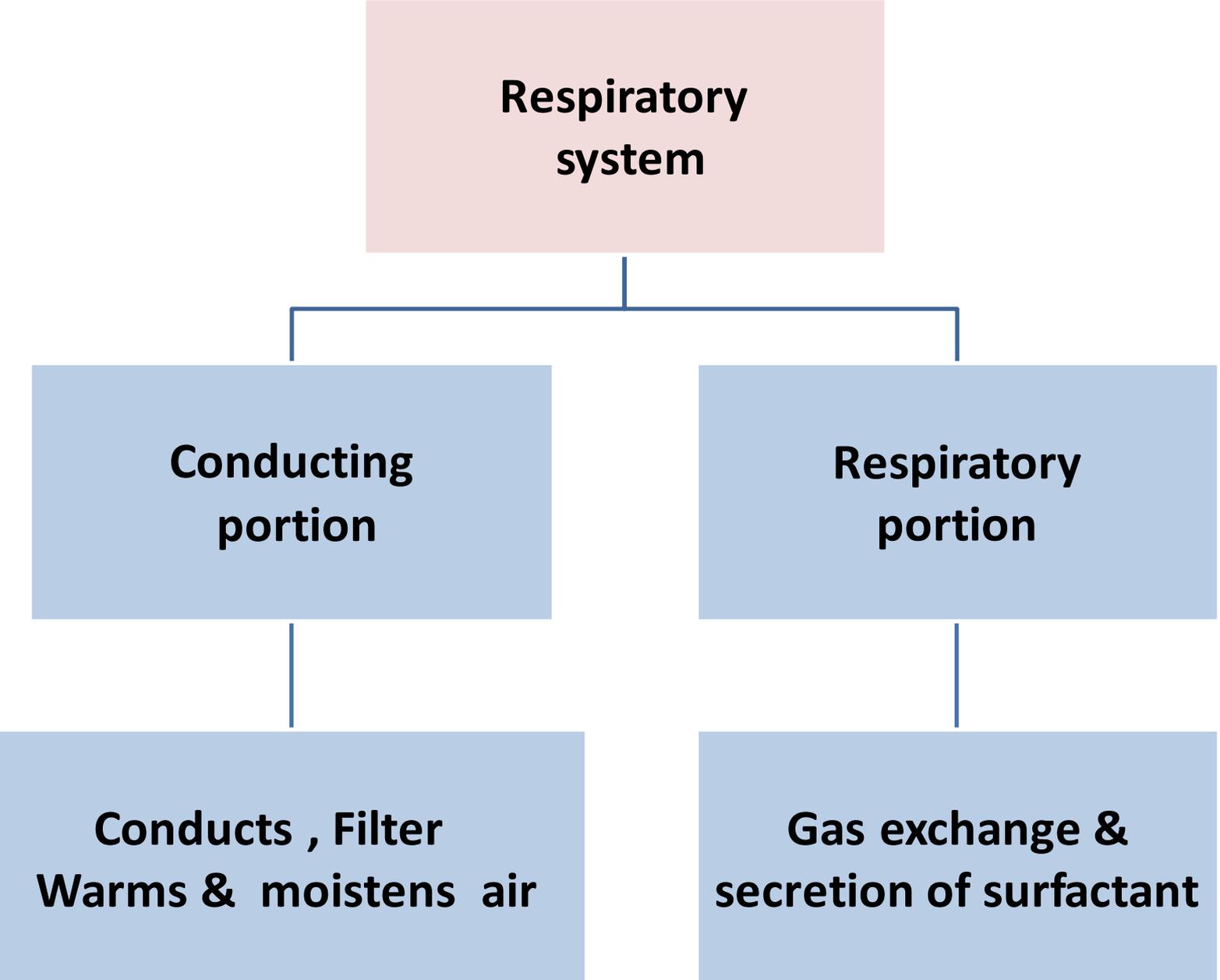
- Structures associated with chemoreceptors of sense of smell



- Phonation



# 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 light red box labeled 'Respiratory system'. A vertical line descends from this box and splits into two horizontal lines. From each horizontal line, a vertical line descends to a light blue box. The left box is labeled 'Conducting portion' and is connected to a larger light blue box below it containing the text 'Conducts , Filter' and 'Warms & moistens air'. The right box is labeled 'Respiratory portion' and is connected to a larger light blue box below it containing the text 'Gas exchange &' and 'secretion of surfactant'.

**Conducting  
portion**

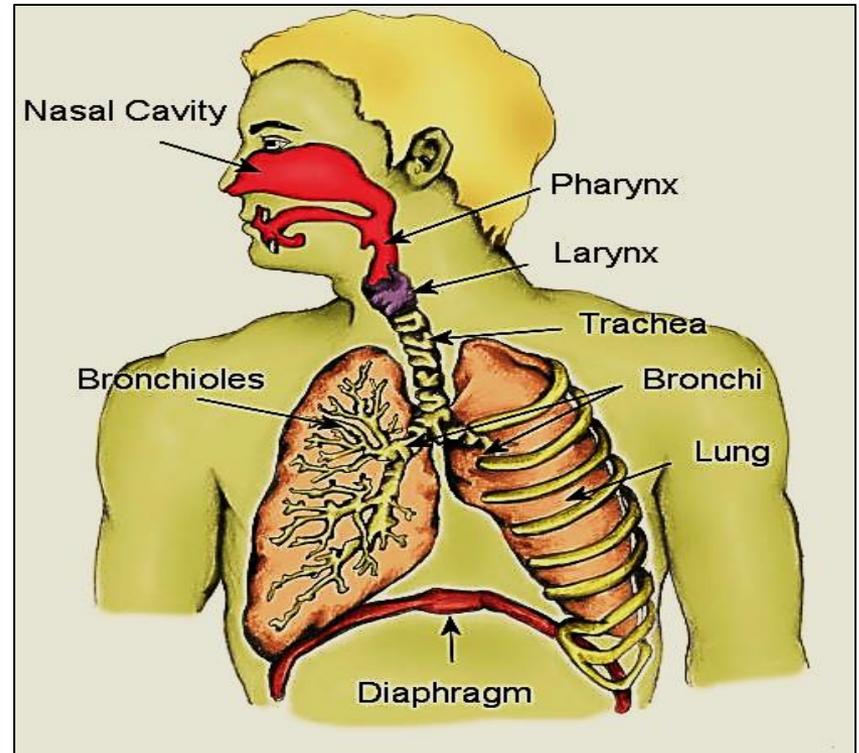
**Conducts , Filter  
Warms & moistens air**

**Respiratory  
portion**

**Gas exchange &  
secretion of surfactant**

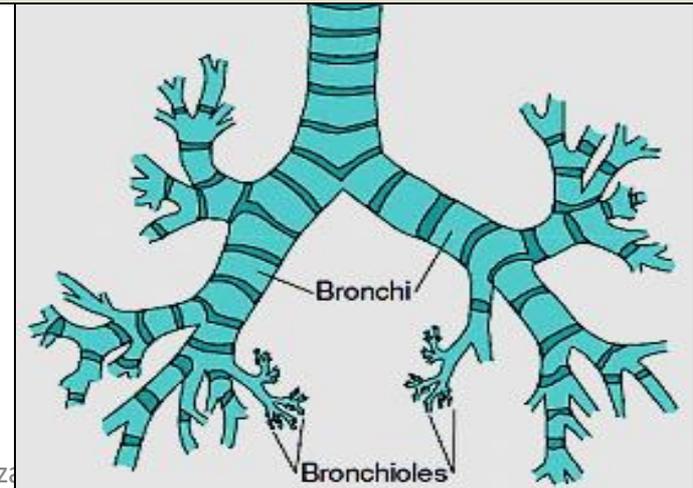
## ➤ A- The conducting portion includes:

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



## Function of conducting portion:

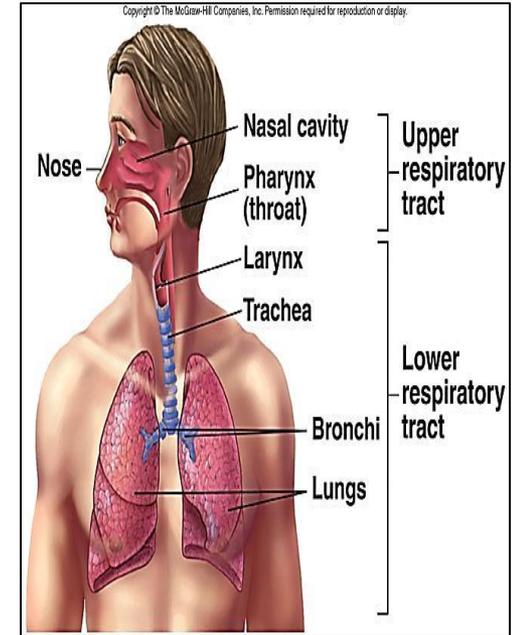
- Conduction of air
- Conditioning of air



# 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

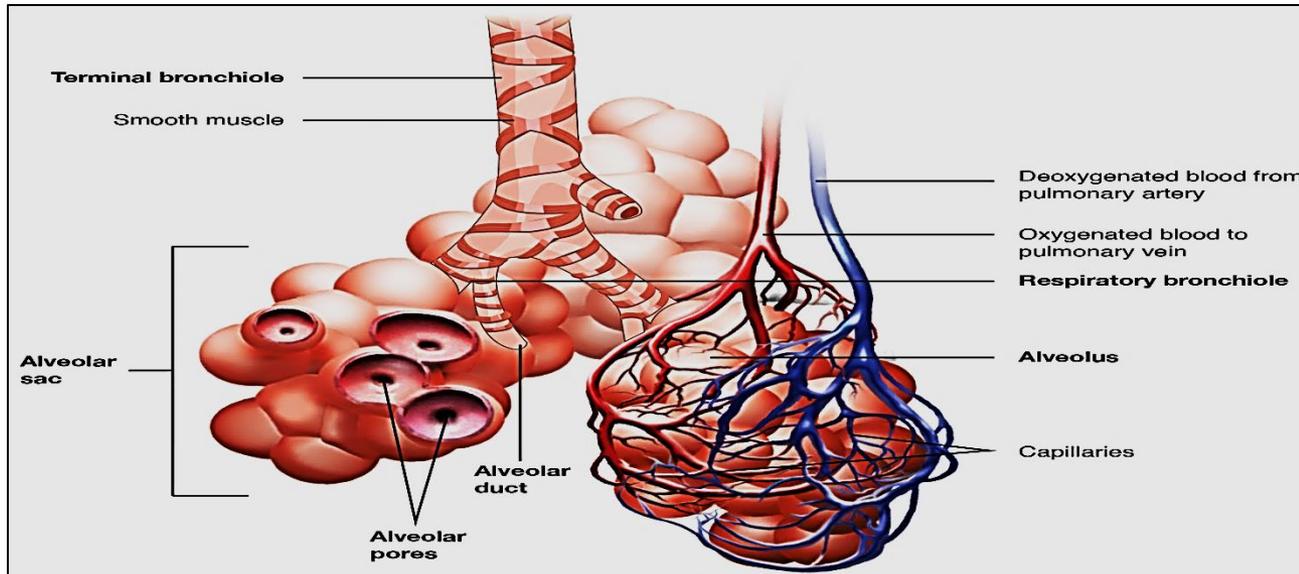
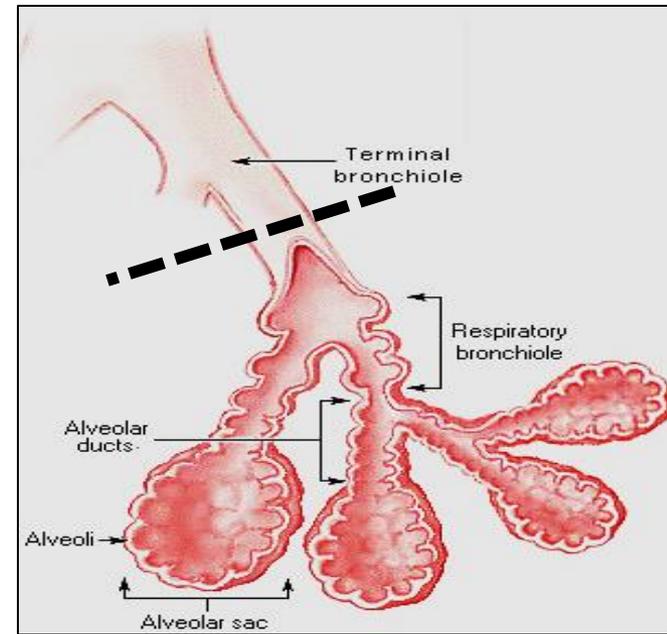


➤ **B- The respiratory portion includes:**

- Respiratory bronchioles
- Alveolar ducts
- Alveolar sacs
- Alveoli

Function of respiratory portion:

O<sub>2</sub>/CO<sub>2</sub> exchange take place between blood & inspired air



# A- Conducting portion

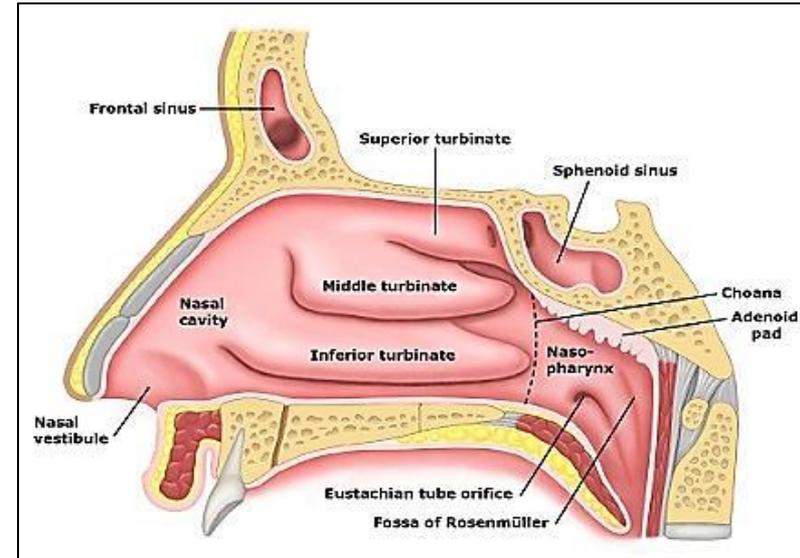
**Nasal cavities:** each consists of:

1- vestibule

2- nasal fossa:

✘ Respiratory area

✘ Olfactory area



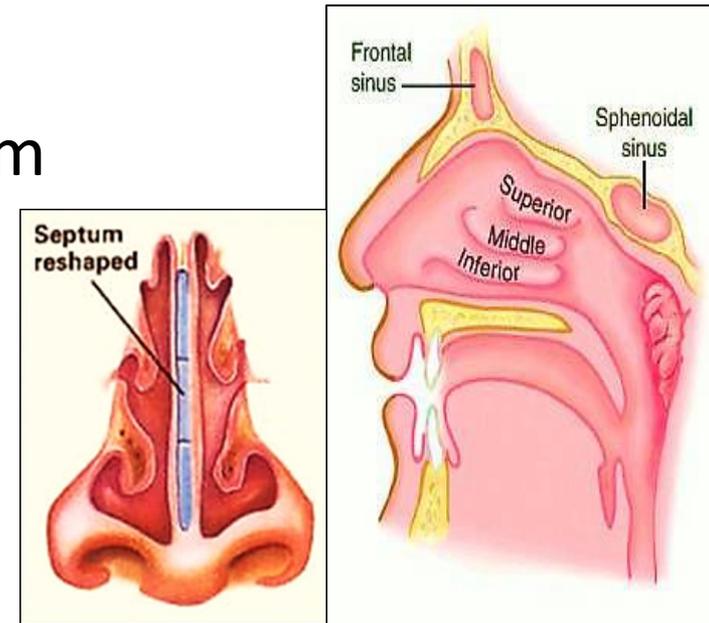
## Vestibule:

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



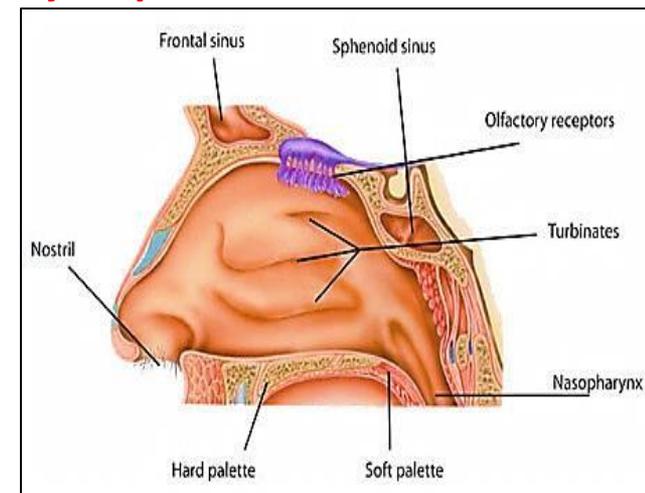
## Nasal fossae:

- 2 cavities separated by nasal septum
- Their lateral walls contain 3 bony projections (conchae) superior, middle, inferior



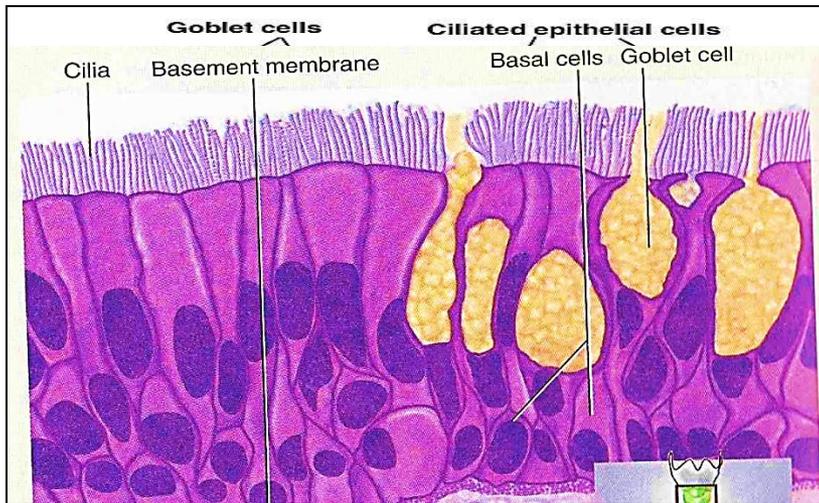
- Superior one covered e **Olfactory epithelium**
- Middle & inferior covered e **Respiratory epithelium**

- The conchae increase the surface area for better conditioning of the inspired air

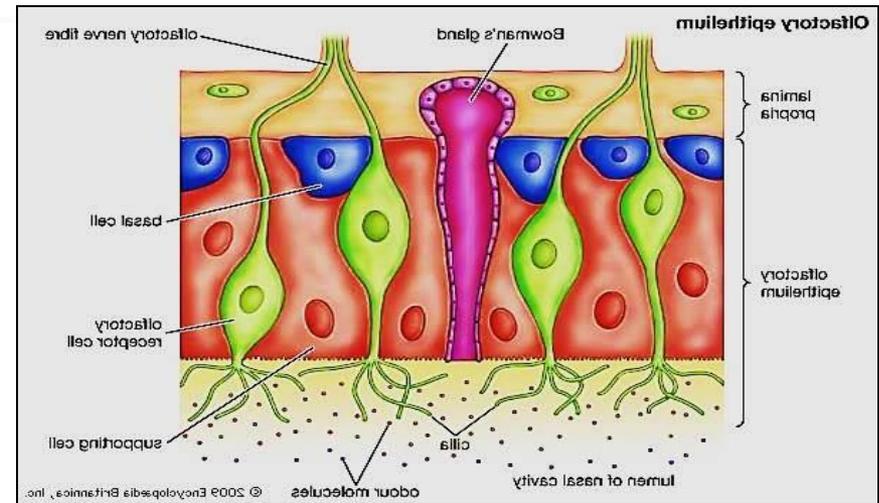


# Q:What is the difference between the respiratory & olfactory epithelium?

## RESPIRATORY



## OLFACTORY



## The respiratory epithelium:

- Pseudostratified columnar ciliated e goblet cells

## The olfactory epithelium:

- Pseudostratified columnar e chemoreceptors & NO goblet cells

# The olfactory epithelium

- Covers the roof of nasal cavities & superior conchae.

- Contains chemoreceptors of smell

- 3 cell types are present:

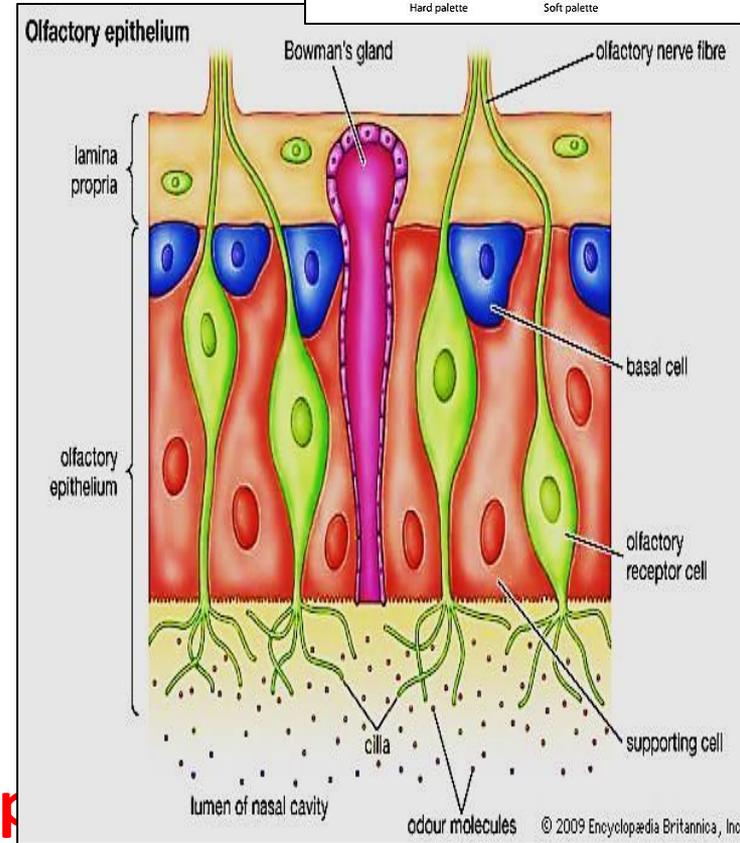
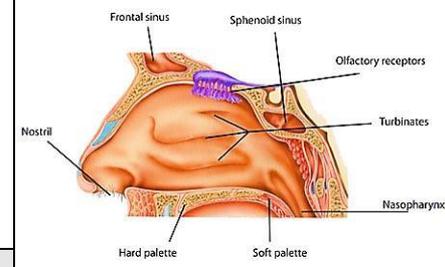
1. Olfactory receptor neurons
2. Supporting (sustentacular) cells
3. Basal cells

- The olfactory mucosa consists of:

1- The epithelium rests on 2- lamina p

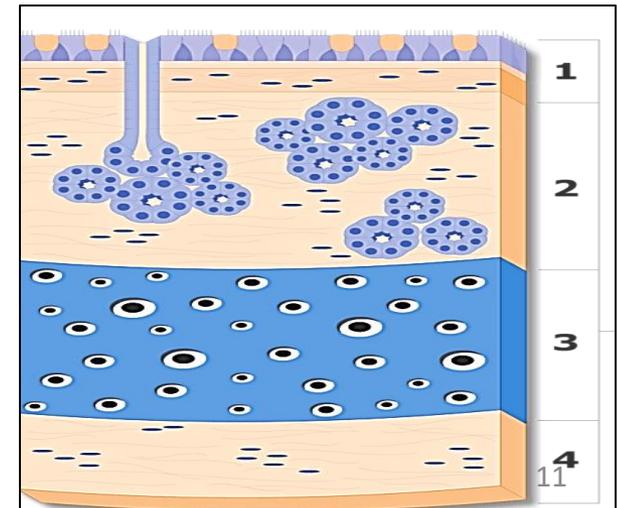
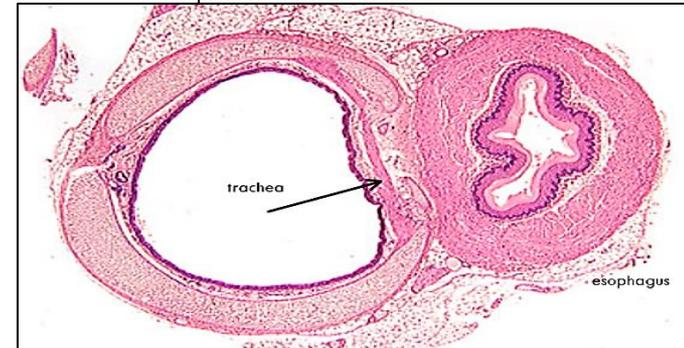
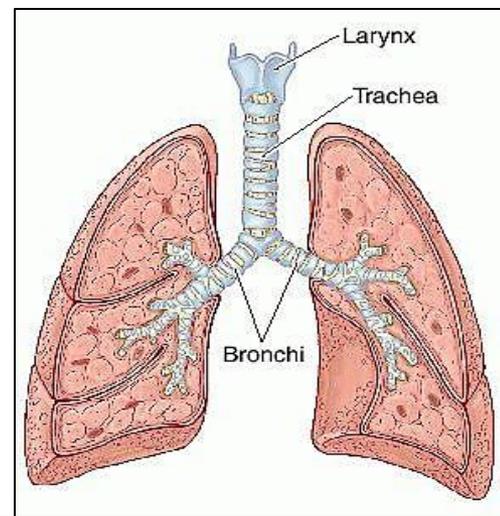
- ✓ BV & olfactory nerve fibers

- ✓ Bowman's glands, secrete serous fluid @ constant flow → surface



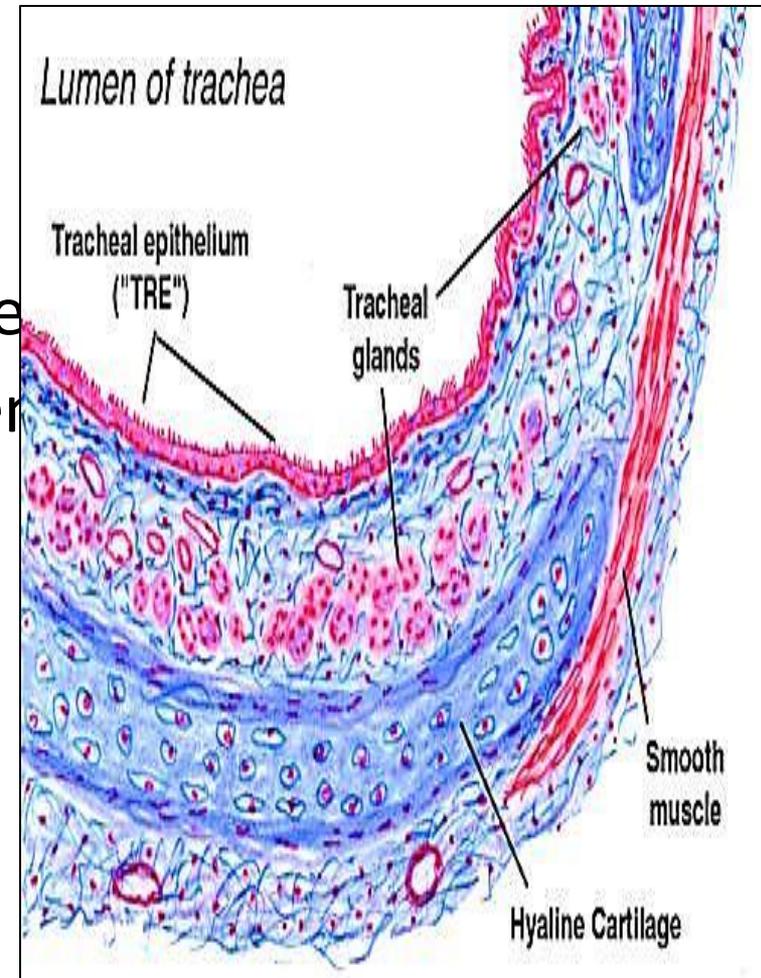
# Trachea

- 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

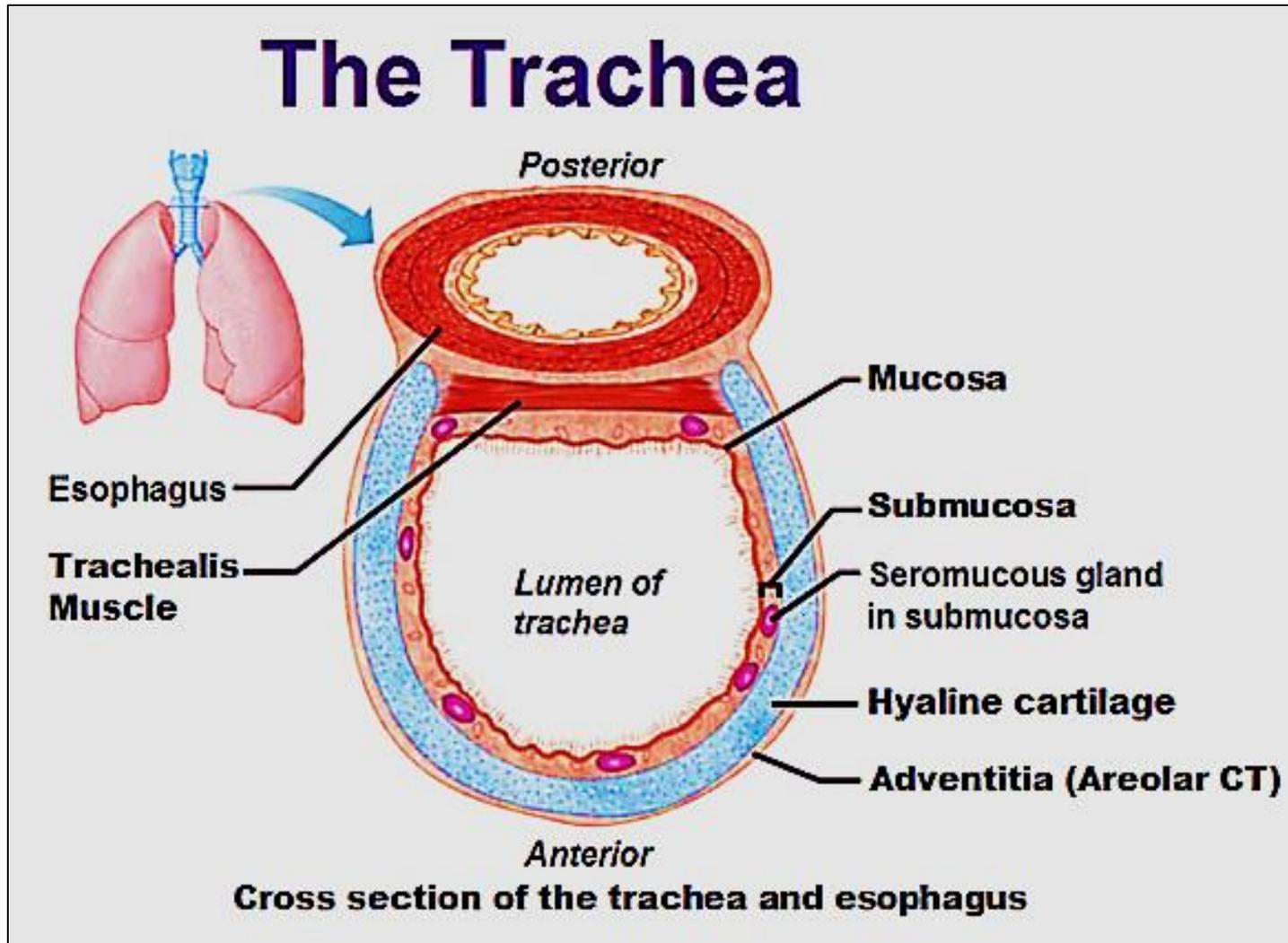


## Wall of trachea:

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

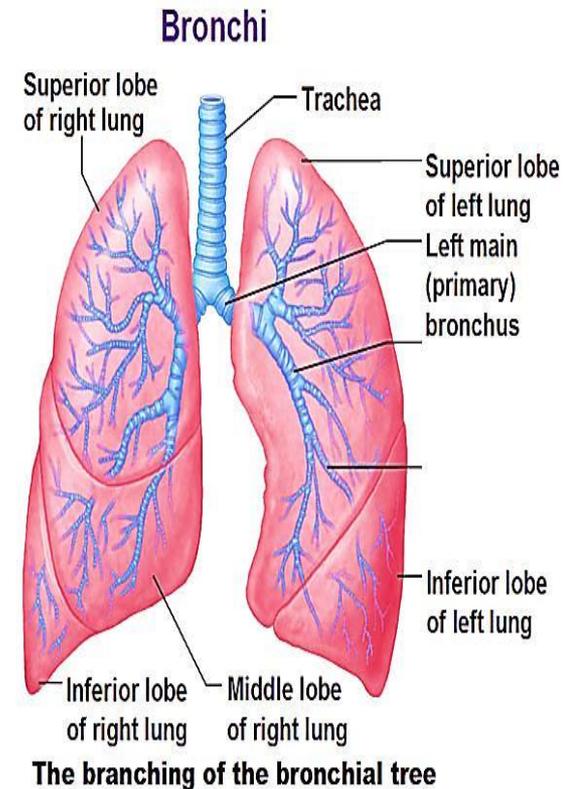


# The Trachea

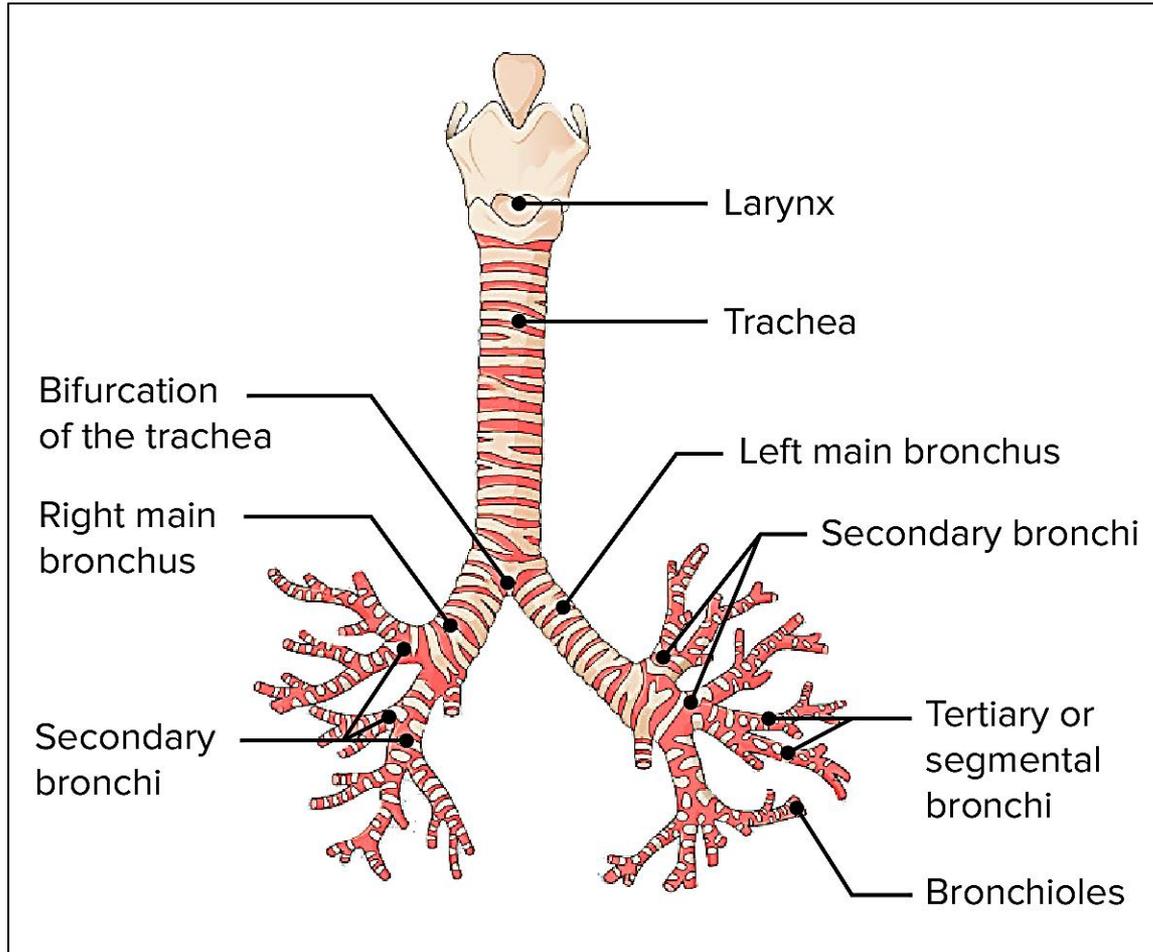


# Bronchial tree

- ✓ Primary (Extra pulmonary) bronchi
  - ✓ Secondary (Intra-pulmonary) bronchi
  - ✓ Bronchioles
  - ✓ Terminal bronchioles
- 1ry bronchi: RT & LF → similar to trachea  
(but cartilage is a complete ring)



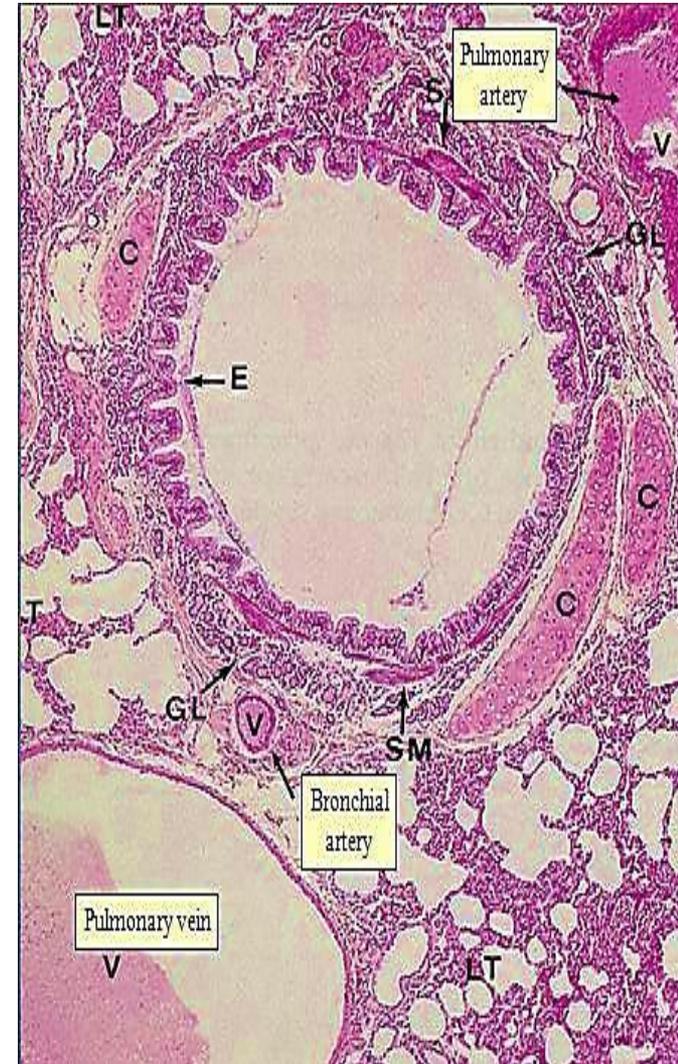
- 2ry bronchi: within the lung → divide into 3ry bronchi  
Its wall is formed of 4 layers (NO Submucosa):
  - Mucosa
  - Muscularis
  - Cartilage plates (isolated plates)
  - Adventitia



**Bronchial tree**

# 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:



## ■ Bronchioles

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

### Mucosa:

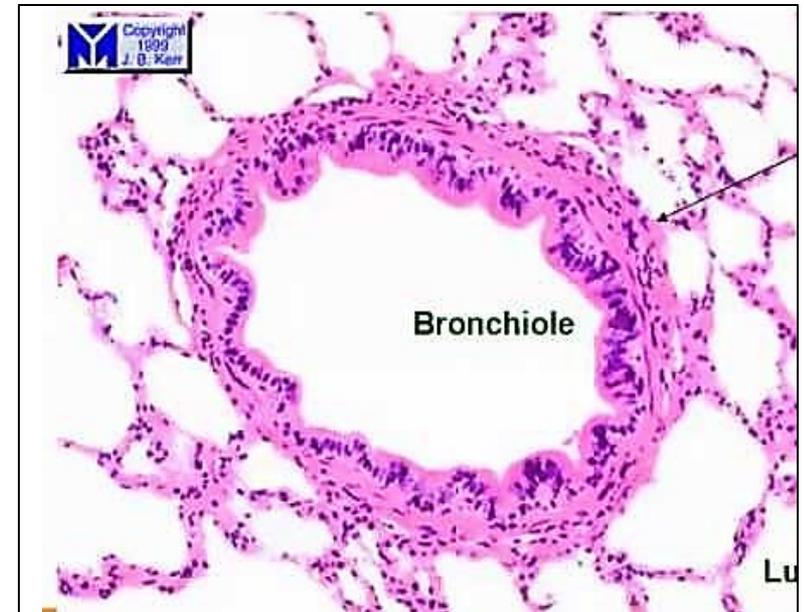
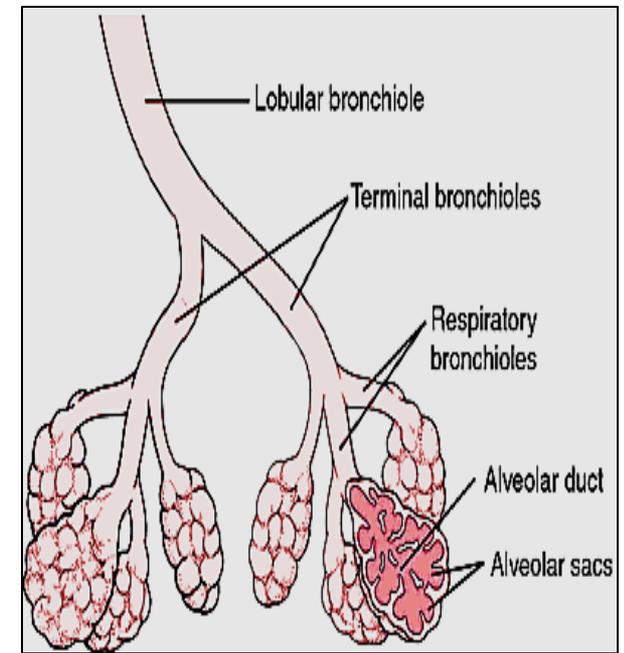
- Simple columnar ciliated+ Clara cells

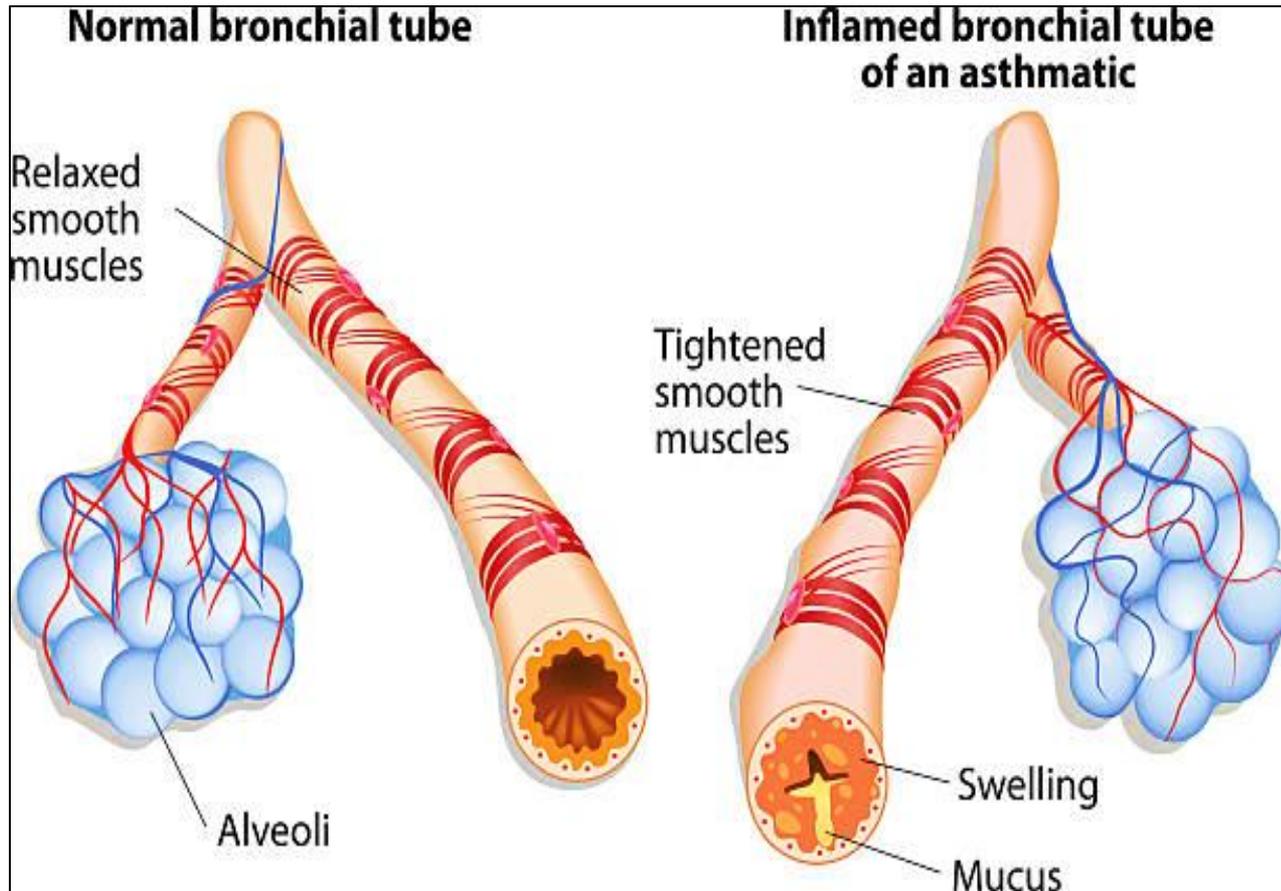
### Musculosa:

complete layer of circularly arranged s.ms.

### Adventitia:

CT layer

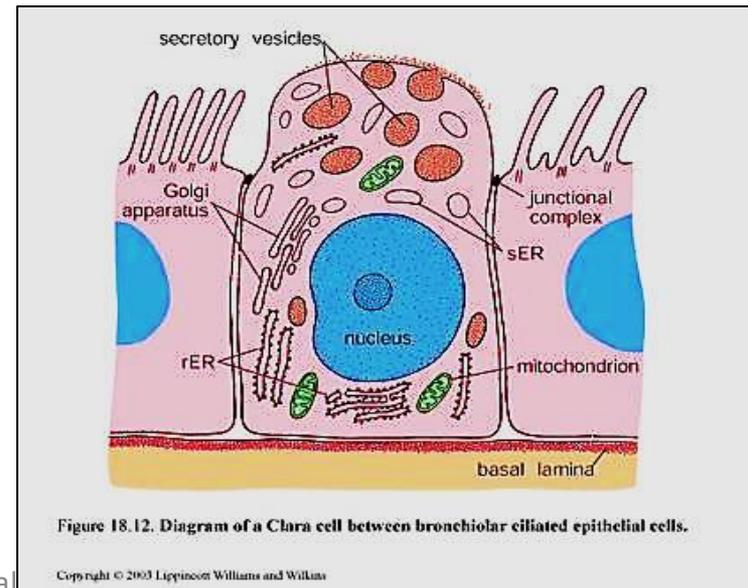
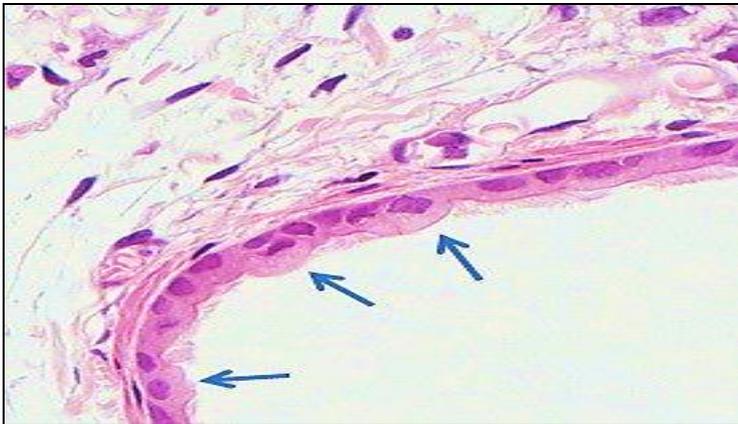




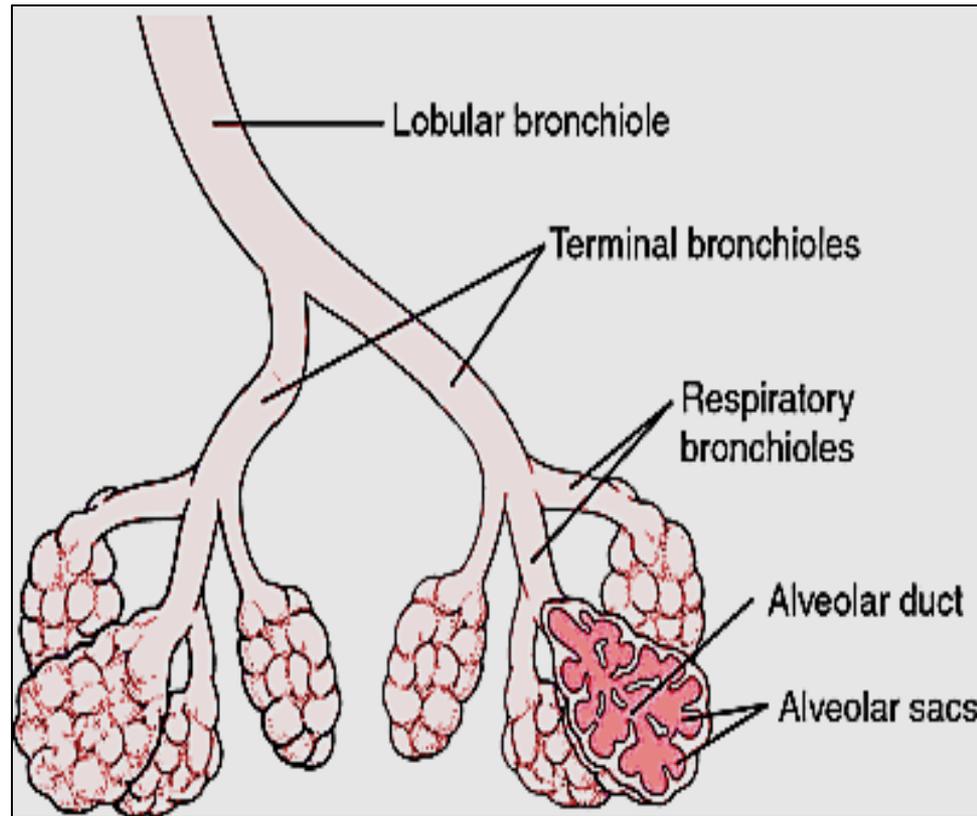
**Bronchiole in asthma vs normal**

# Clara cells

- Dome-shaped apex, non-ciliated,
- Cytoplasm has lots of secretory granules (not mucus)  
basal rER, apical sER
- They act as stem cells
- They play a role in degradation of inhaled toxins (sER)
- Secrete *surfactant-like which prevent collapse of bronchioles*
- Has defensive role



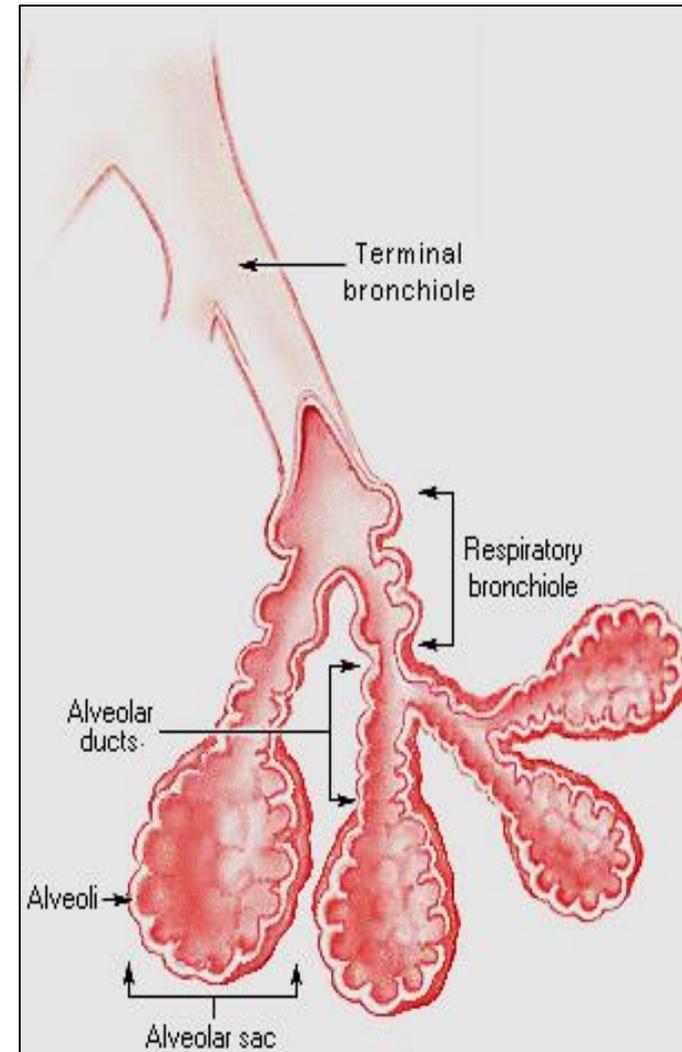
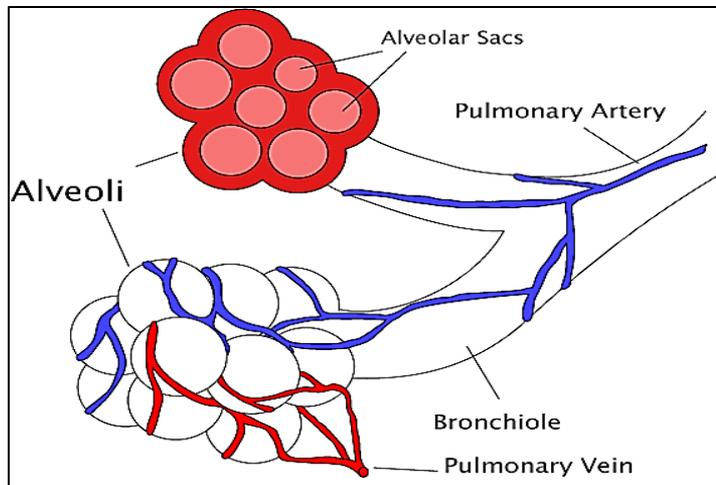
## ■ Terminal bronchioles:



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

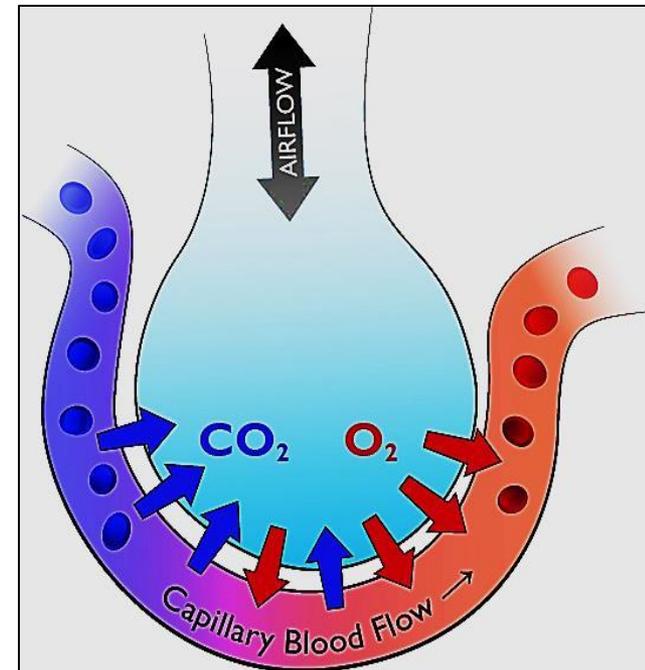
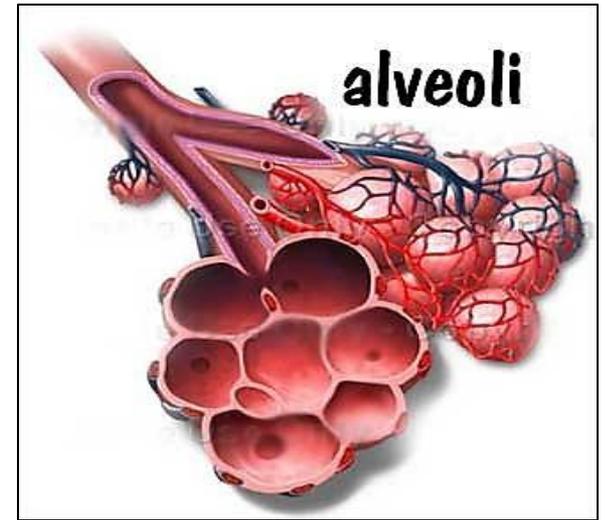
# B- respiratory portion

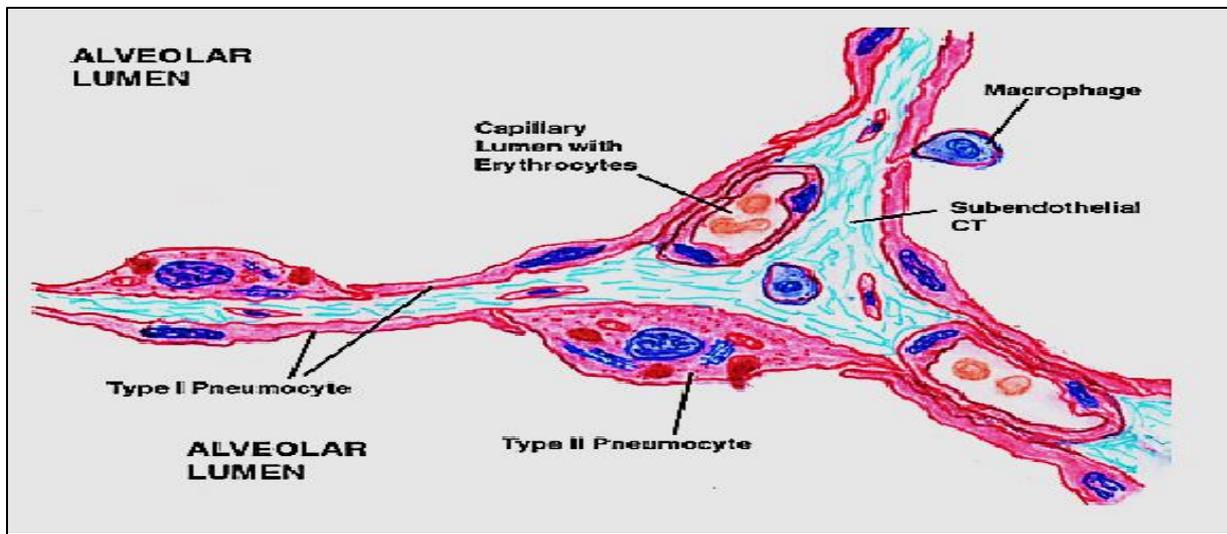
- Is where gas exchange takes place
- Includes:
  - ✓ Respiratory bronchioles
  - ✓ Alveolar ducts
  - ✓ Alveolar sacs
  - ✓ Alveoli



# 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



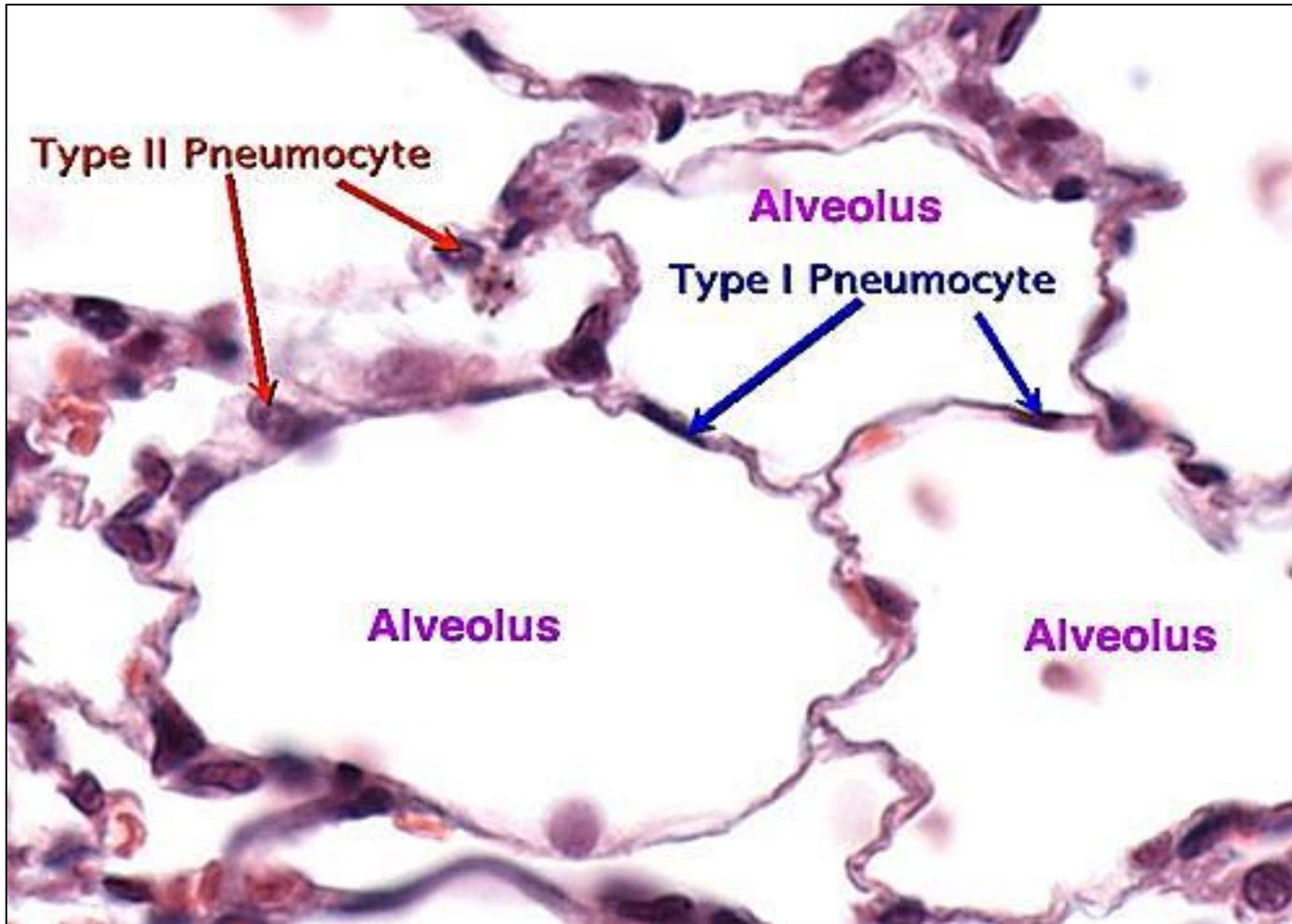


## Type I pneumocytes

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

## Type II pneumocytes

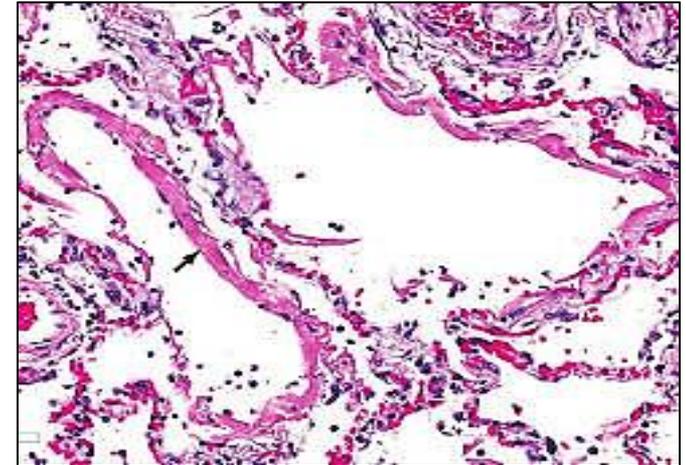
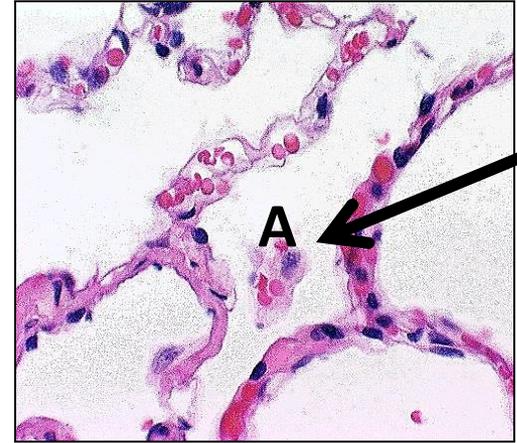
- 3%
- Cuboidal cells e central nuclei & foamy cytoplasm
- Function: Secrete surfactant + stem cells
- Have ACE2 receptors where Covid-19 spikes attack



## Type I and type II pneumocytes

## Interalveolar septa

- Delicate walls separate adjacent alveoli
- Have **richest capillary network**
- **Where Gas exchange Take place**
- **Contains Blood –air barrier**
- Contains extravasated leucocytes (**monocytes**), which will migrate through the wall → to the lumen and become alveolar macrophages ( arrow A)
- This septa is destructed in emphysema & **Covid - 19**



# Thank you

