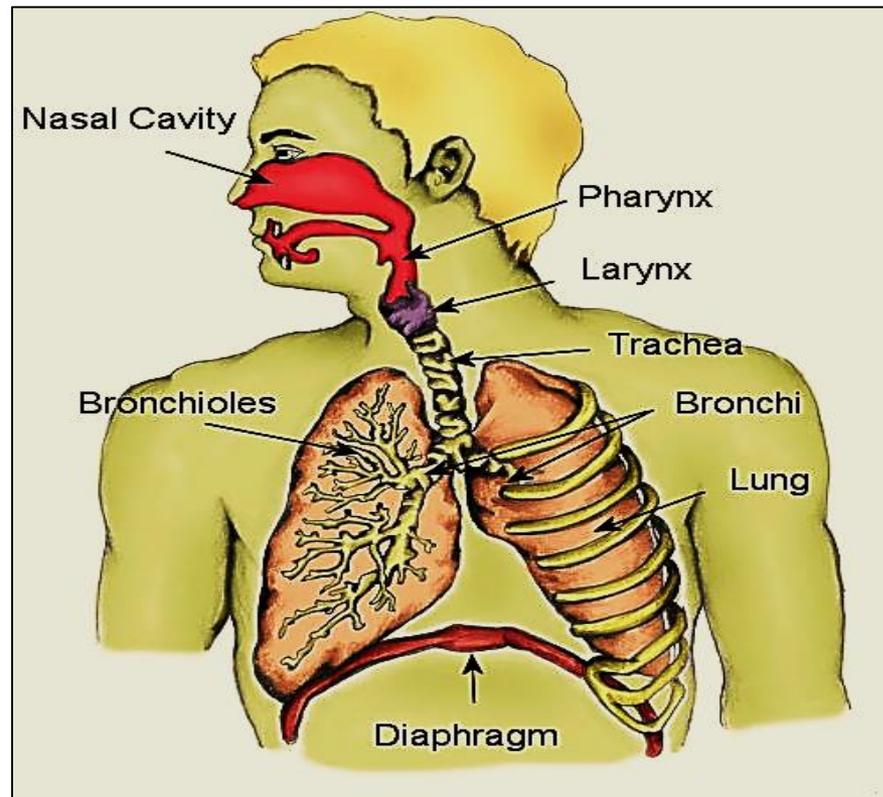


Introduction to The respiratory system 2023

Professor Dr. Hala El-mazar



By studying the respiratory system we learn about:

- structures involved in inspiration of air, gas exchange, expiration of CO₂



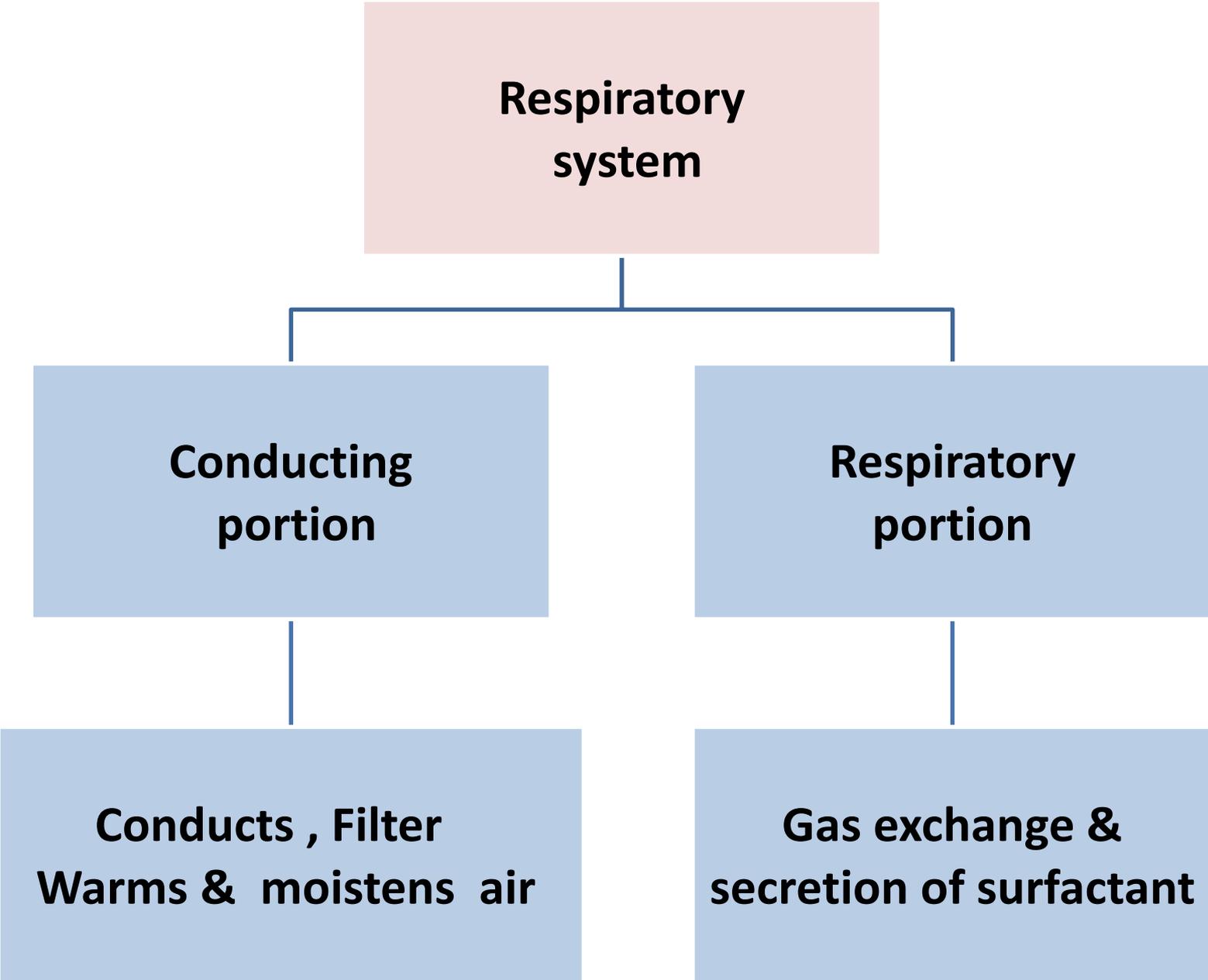
- Structures associated with chemoreceptors of sense of smell



- 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 the left horizontal line, a vertical line leads down to a light blue box labeled 'Conducting portion'. From the right horizontal line, a vertical line leads down to another light blue box labeled 'Respiratory portion'. From the bottom of the 'Conducting portion' box, a vertical line leads down to a larger light blue box containing the text 'Conducts , Filter' and 'Warms & moistens air'. From the bottom of the 'Respiratory portion' box, a vertical line leads down to another larger light blue box containing the text 'Gas exchange &' and 'secretion of surfactant'.

**Conducting
portion**

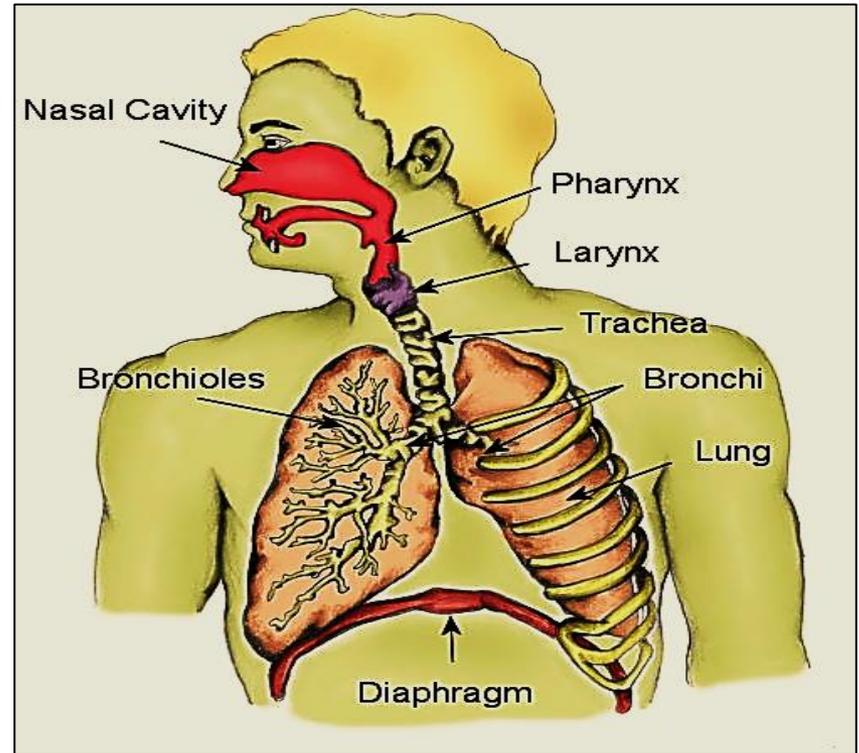
**Conducts , Filter
Warms & moistens air**

**Respiratory
portion**

**Gas exchange &
secretion of surfactant**

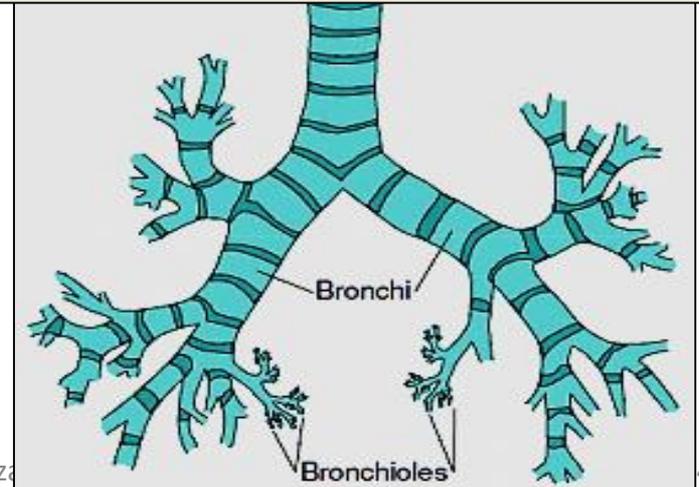
➤ A- The conducting portion includes:

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



Function of conducting portion:

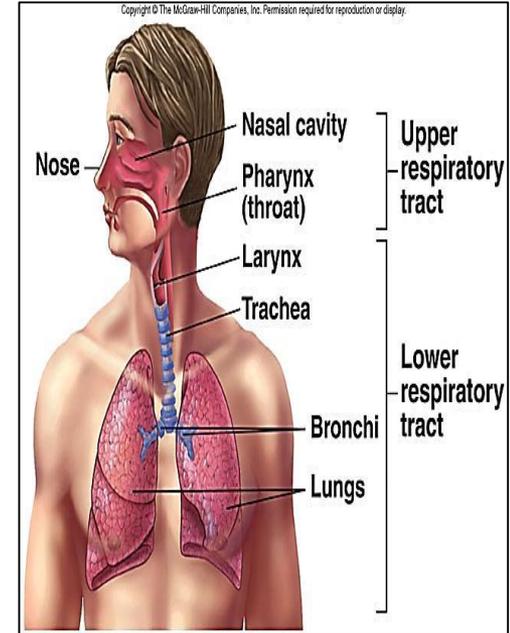
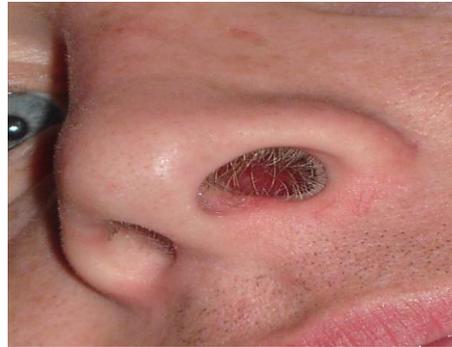
- Conduction of air
- Conditioning of air



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

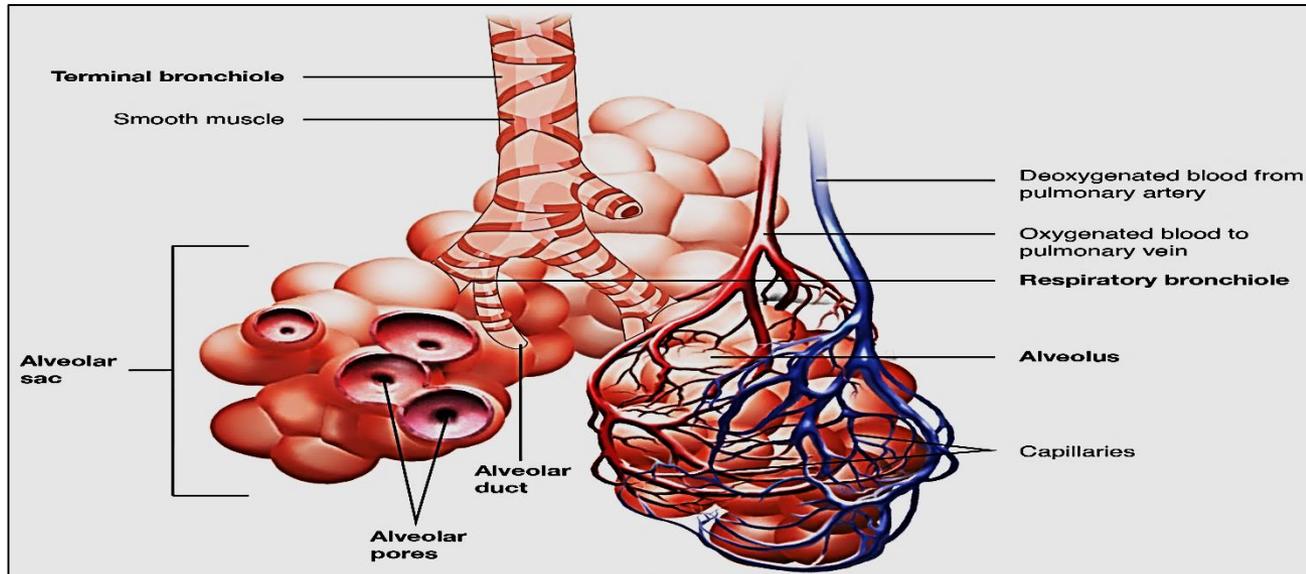
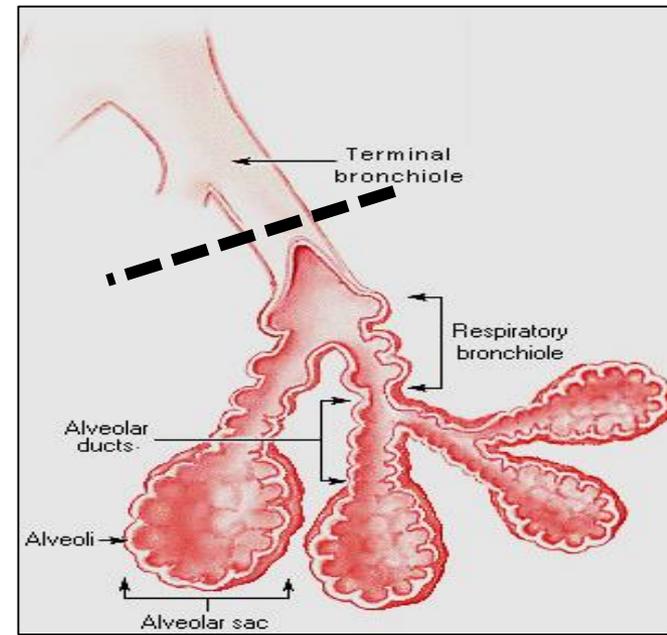


➤ **B- The respiratory portion includes:**

- Respiratory bronchioles
- Alveolar ducts
- Alveolar sacs
- Alveoli

Function of respiratory portion:

O₂/CO₂ exchange take place between blood & inspired air



A- Conducting portion

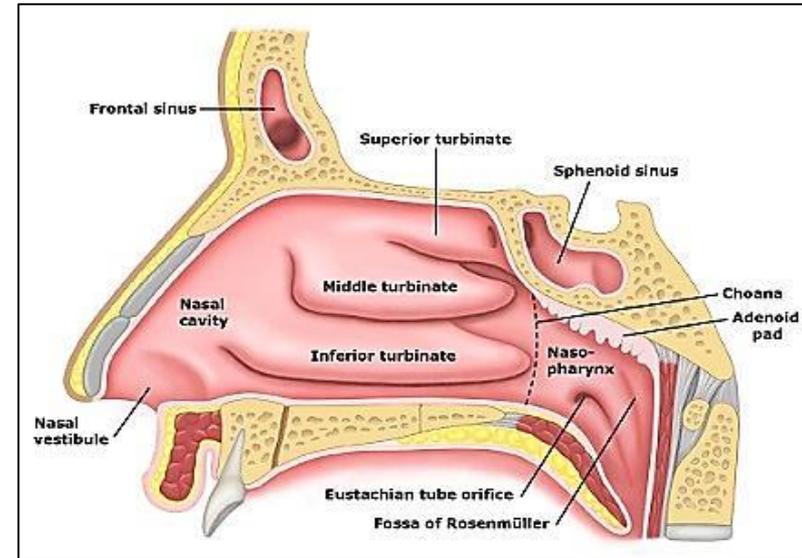
Nasal cavities: each consists of:

1- vestibule

2- nasal fossa:

✘ Respiratory area

✘ Olfactory area



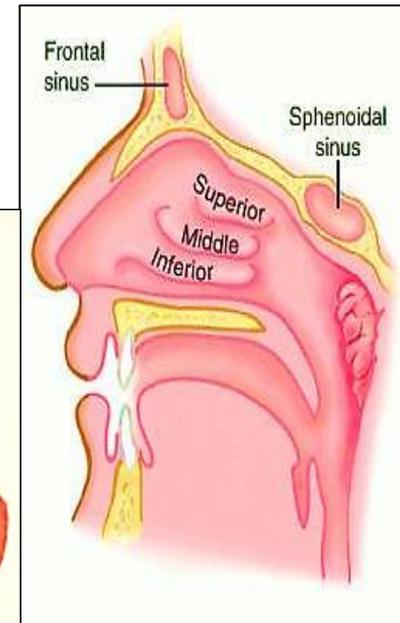
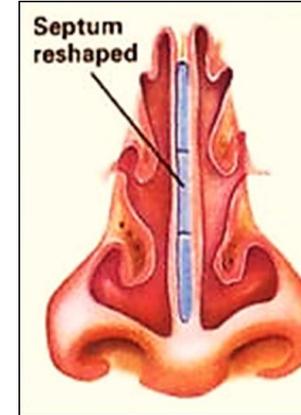
Vestibule:

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



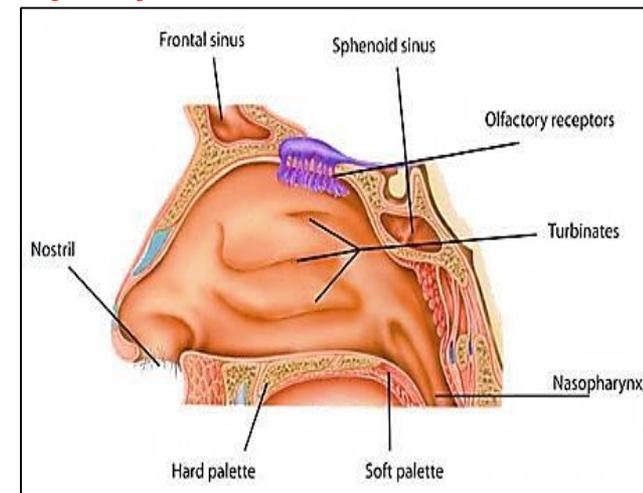
Nasal fossae:

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



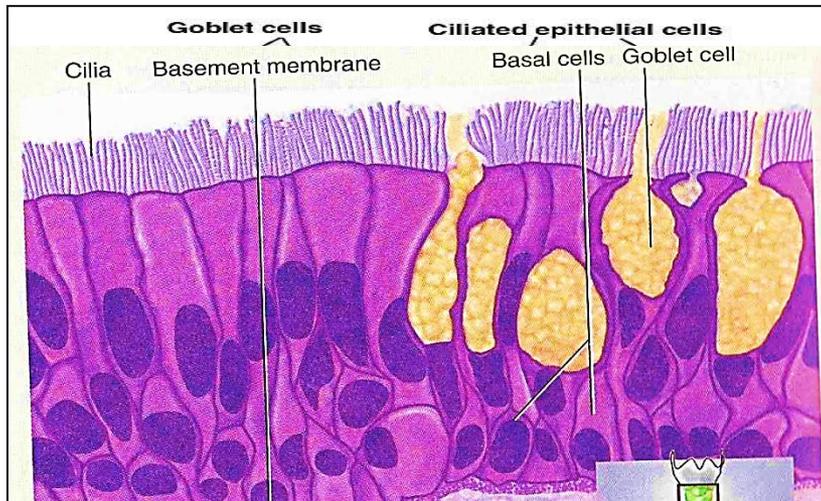
- Superior one covered e **Olfactory epithelium**
- Middle & inferior covered e **Respiratory epithelium**

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

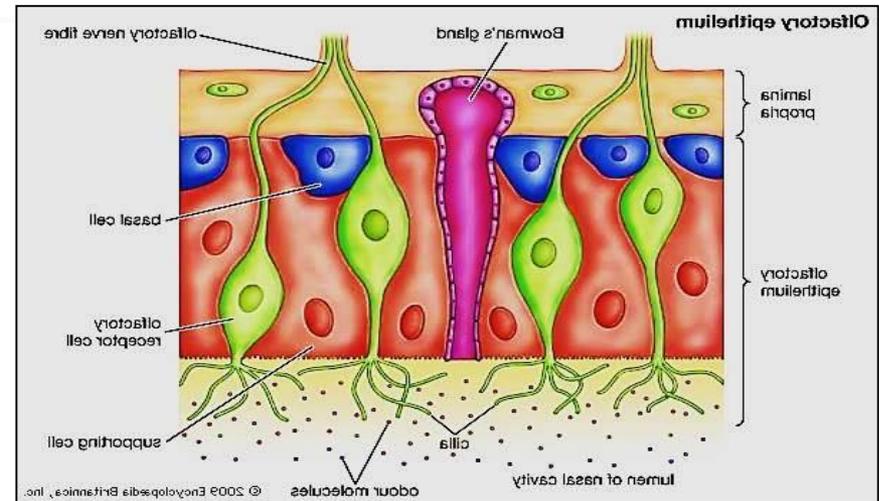


Q:What is the difference between the respiratory & olfactory epithelium?

RESPIRATORY



OLFACTORY



The respiratory epithelium:

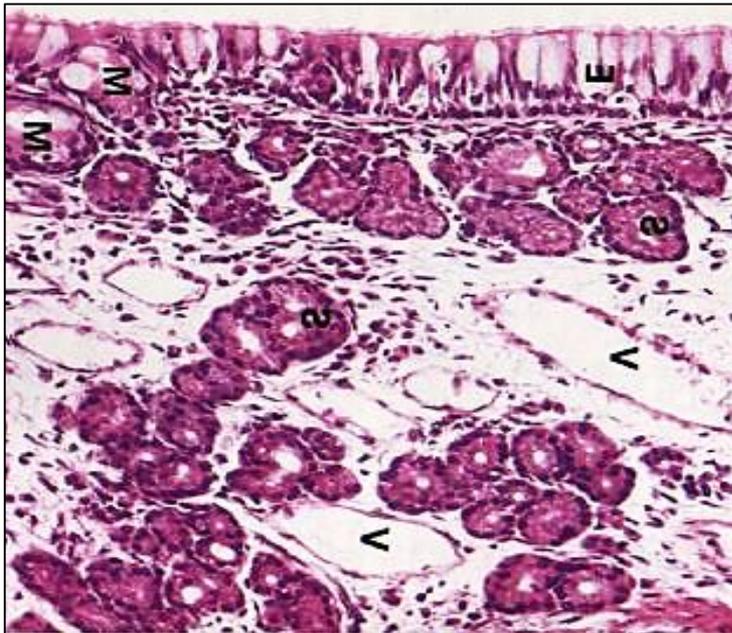
- Pseudostratified columnar ciliated e goblet cells

The olfactory epithelium:

- Pseudostratified columnar e chemoreceptors & NO goblet cells

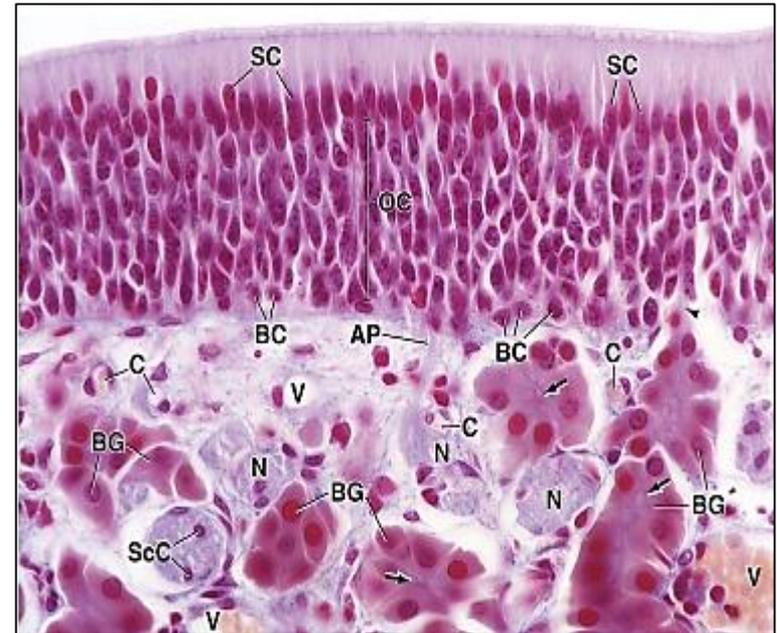
Respiratory mucosa

- Epithelium
- Lamina propria
- Nasal glands (M & S)
- Blood vessels



Olfactory mucosa

- Epithelium
- Lamina propria
- Olfactory glands (S only)
- Blood vessels



The olfactory epithelium

- Covers the roof of nasal cavities & superior conchae.

- Contains chemoreceptors of smell

- 3 cell types are present:

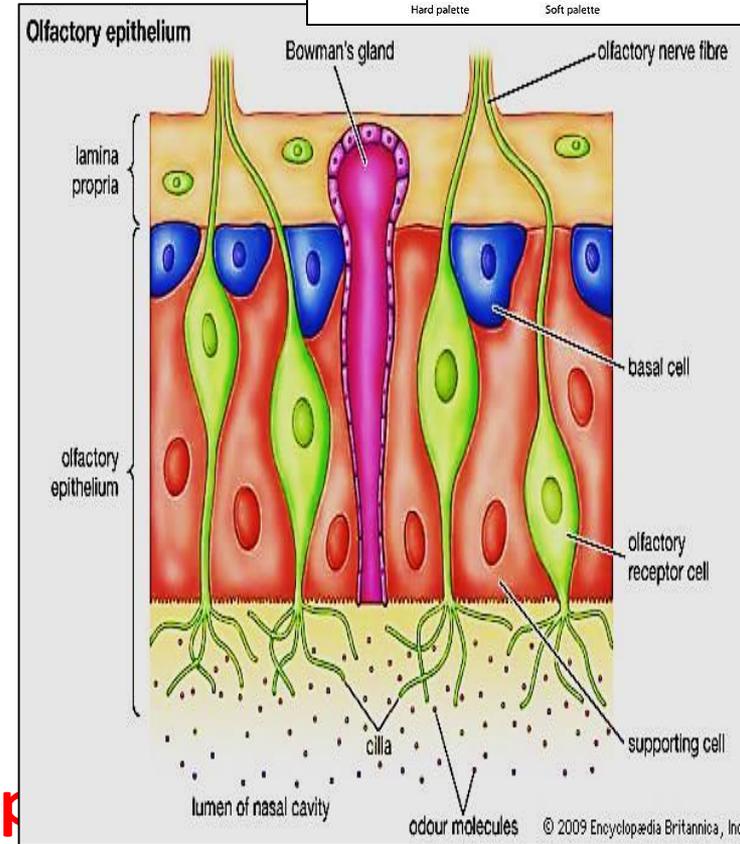
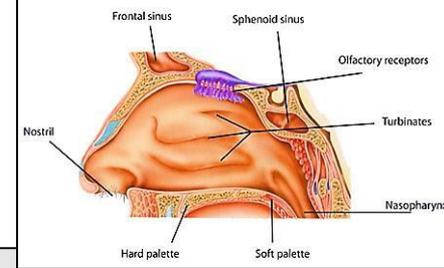
- Olfactory receptor neurons
- Supporting (sustentacular) cells
- Basal cells

- The olfactory mucosa consists of:

1- The epithelium rests on 2- lamina p

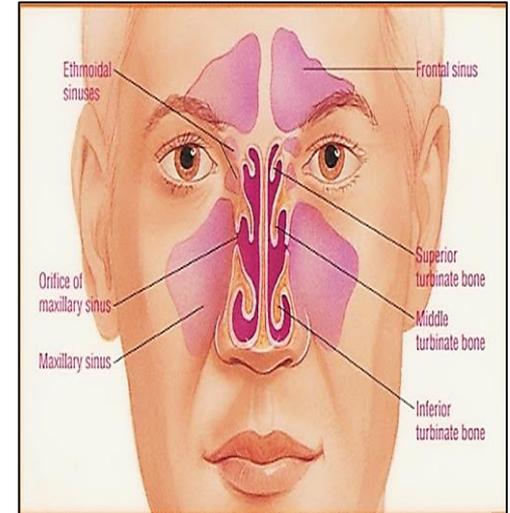
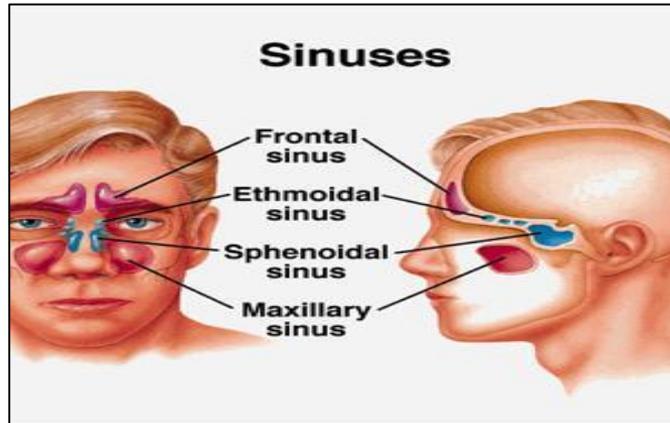
- ✓ BV & olfactory nerve fibers

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



Paranasal sinuses (4 pairs)

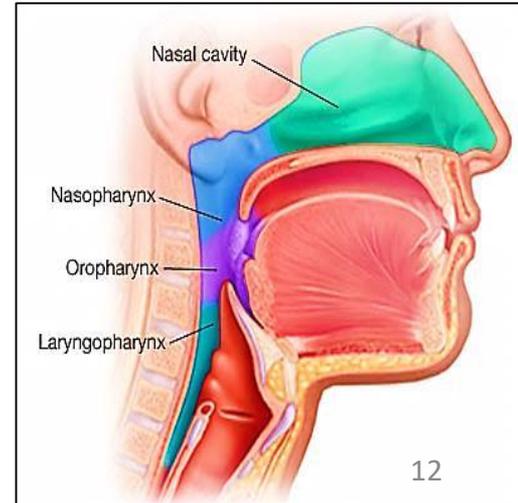
- Frontal, ethmoidal, Sphenoidal, maxillary



- Air-filled spaces open in nasal cavity
- Lined e **thin** respiratory epithelium e few goblet cells , which is very adherent to the periosteum

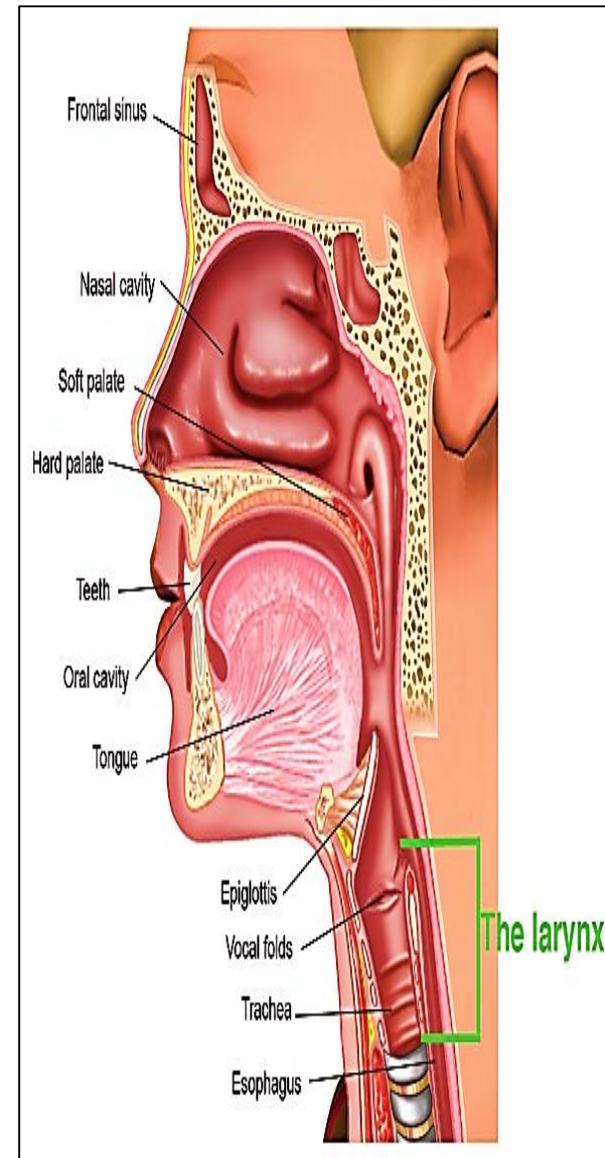
Nasopharynx

- Lined e respiratory epithelium



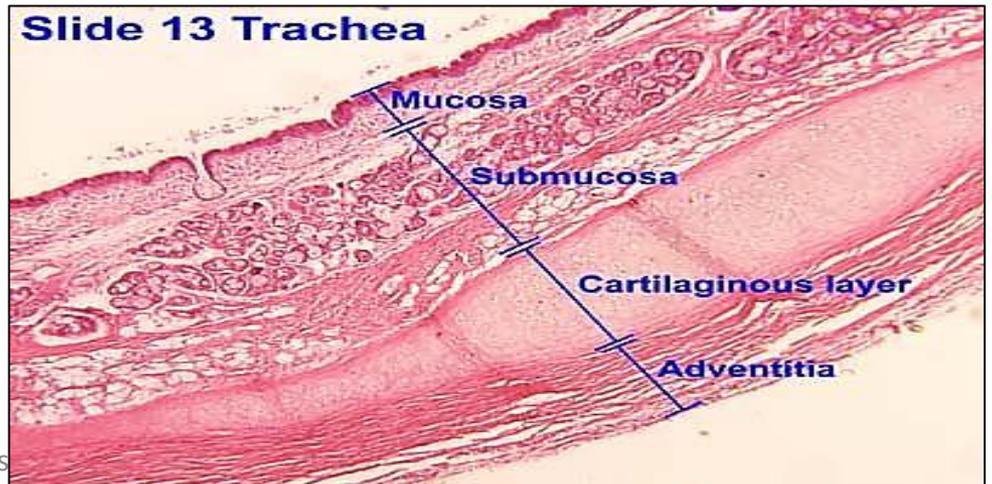
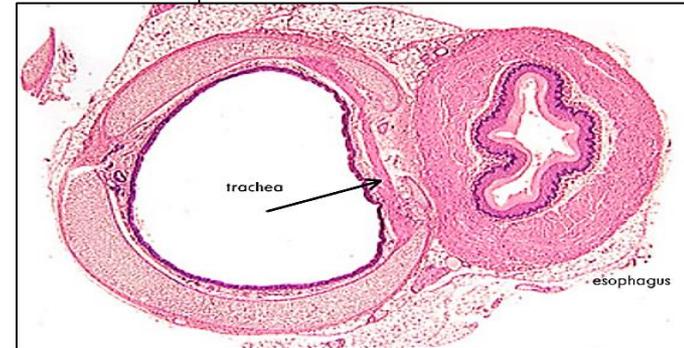
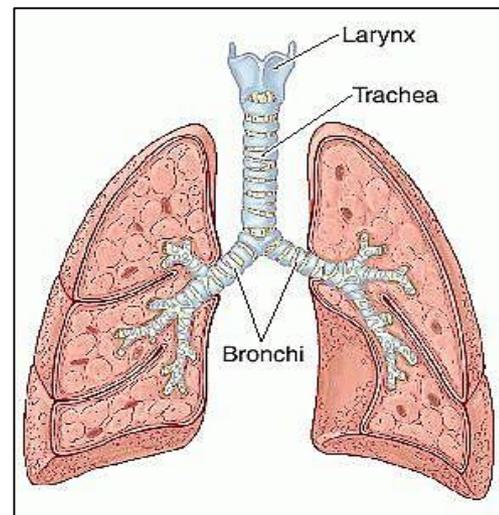
Larynx (voice box):

- 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 e respiratory epithelium



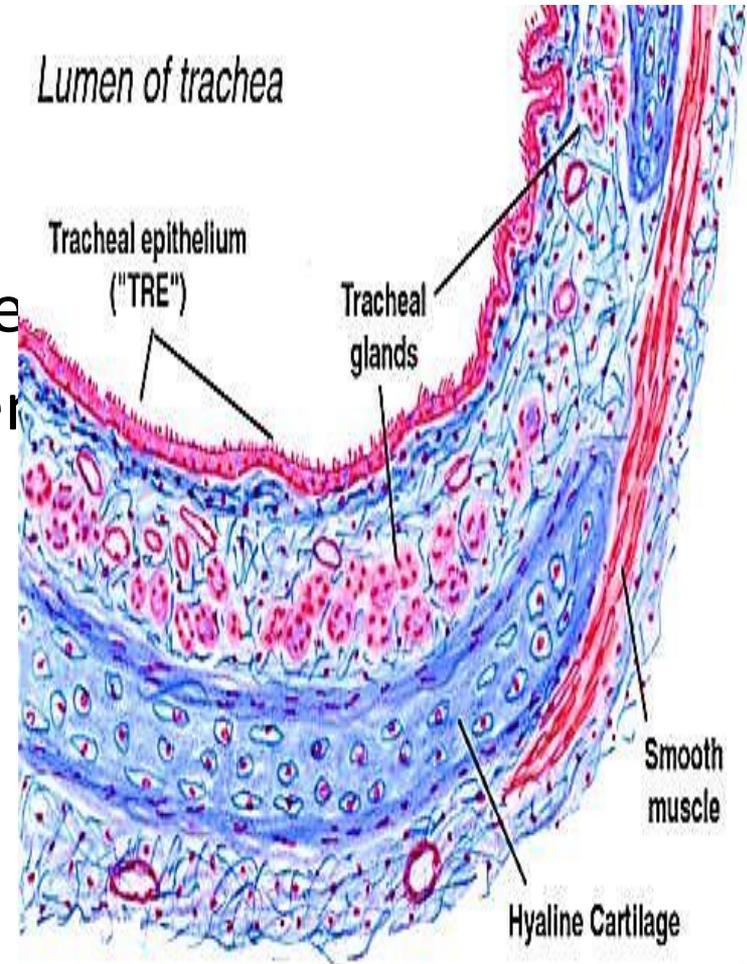
Trachea

- 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

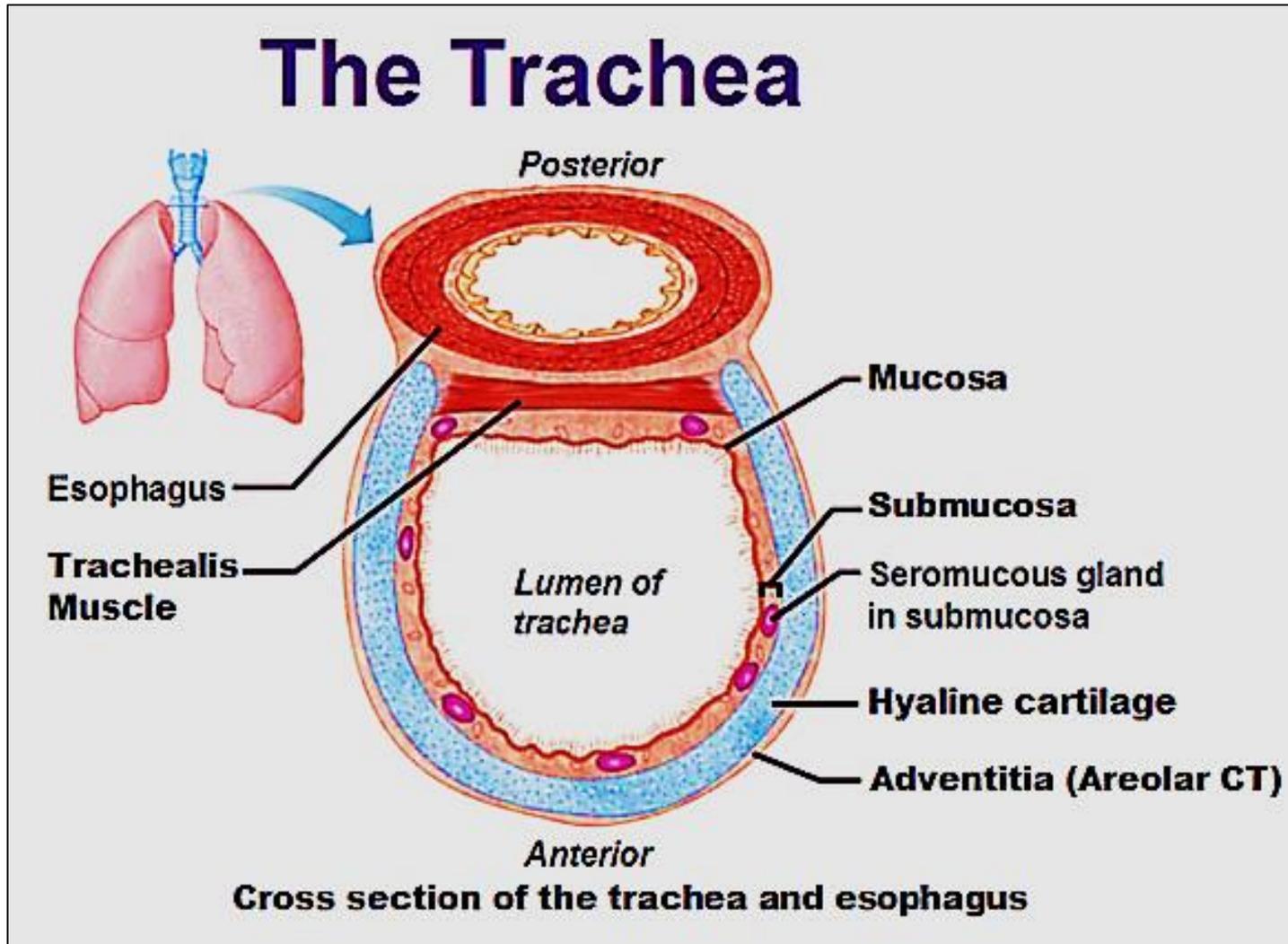


Wall of trachea:

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

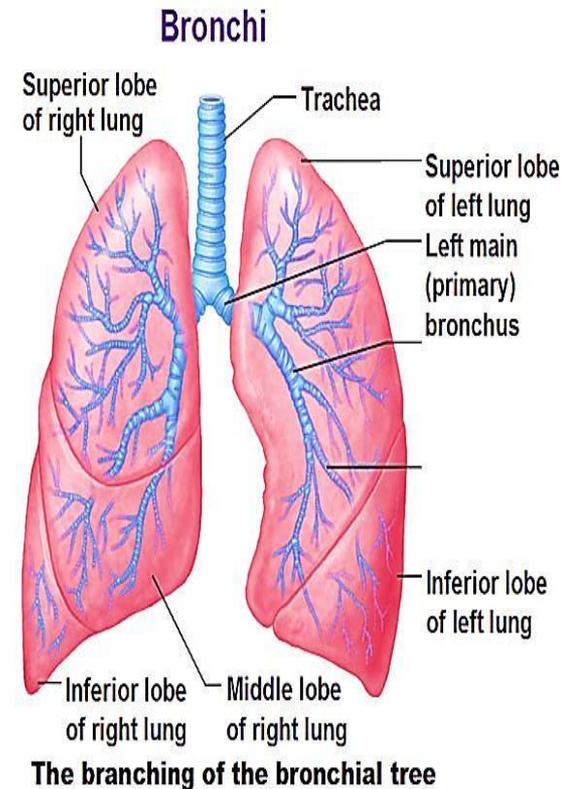


The Trachea



Bronchial tree

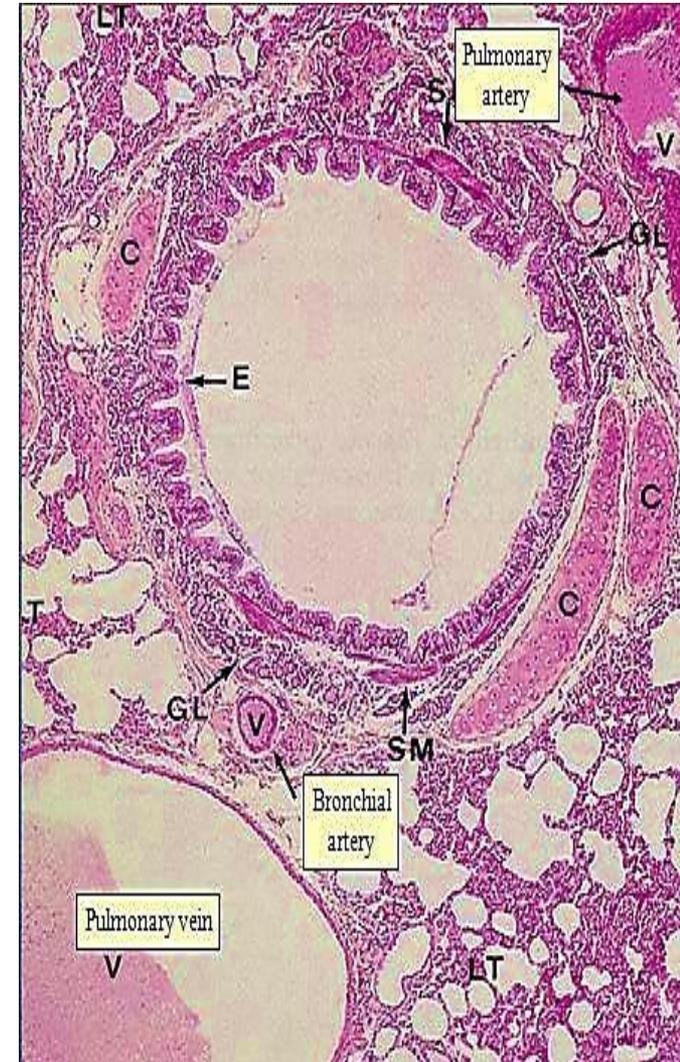
- ✓ Primary (Extra pulmonary) bronchi
 - ✓ Secondary (Intra-pulmonary) bronchi
 - ✓ Bronchioles
 - ✓ Terminal bronchioles
- 1ry bronchi: RT & LF → similar to trachea
(but cartilage is a complete ring)



- 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

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:

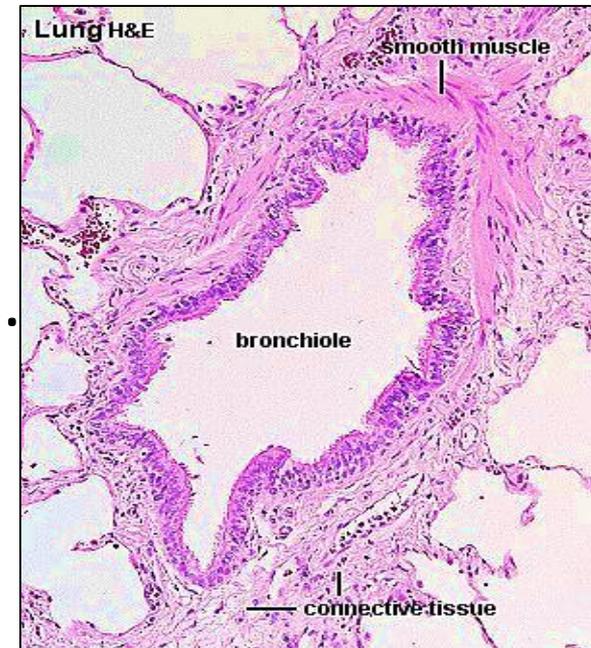
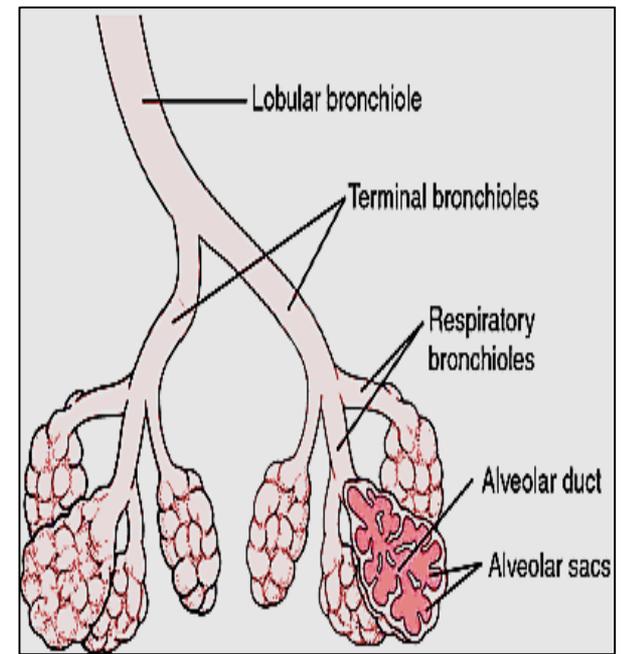
- Simple columnar ciliated+ Clara cells

Musculosa:

complete layer of circularly arranged s.ms.

Adventitia:

CT layer



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

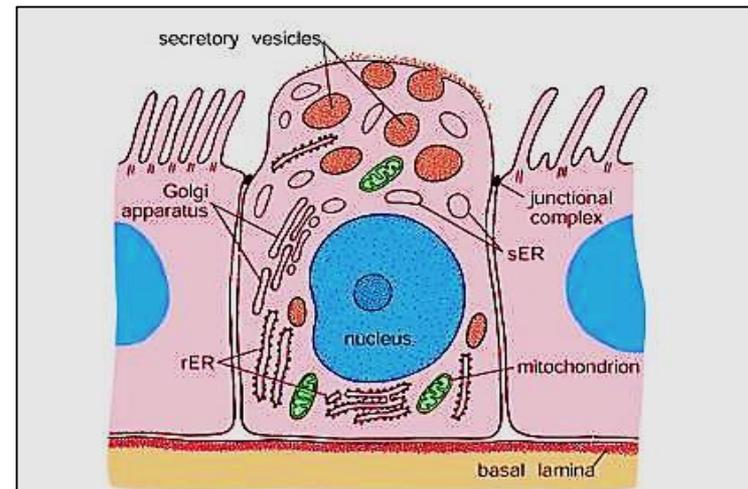
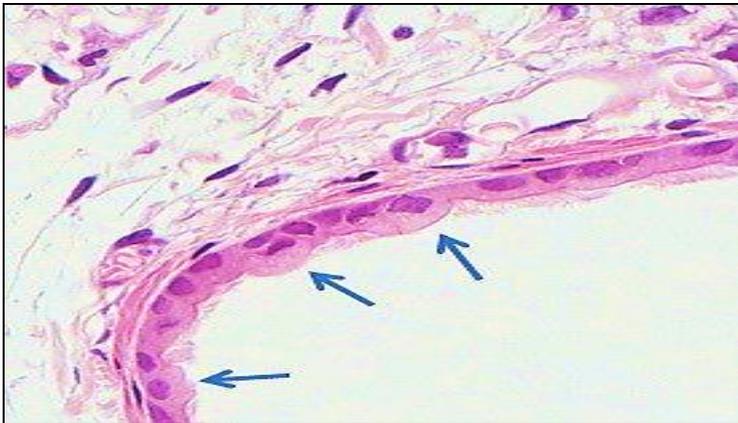
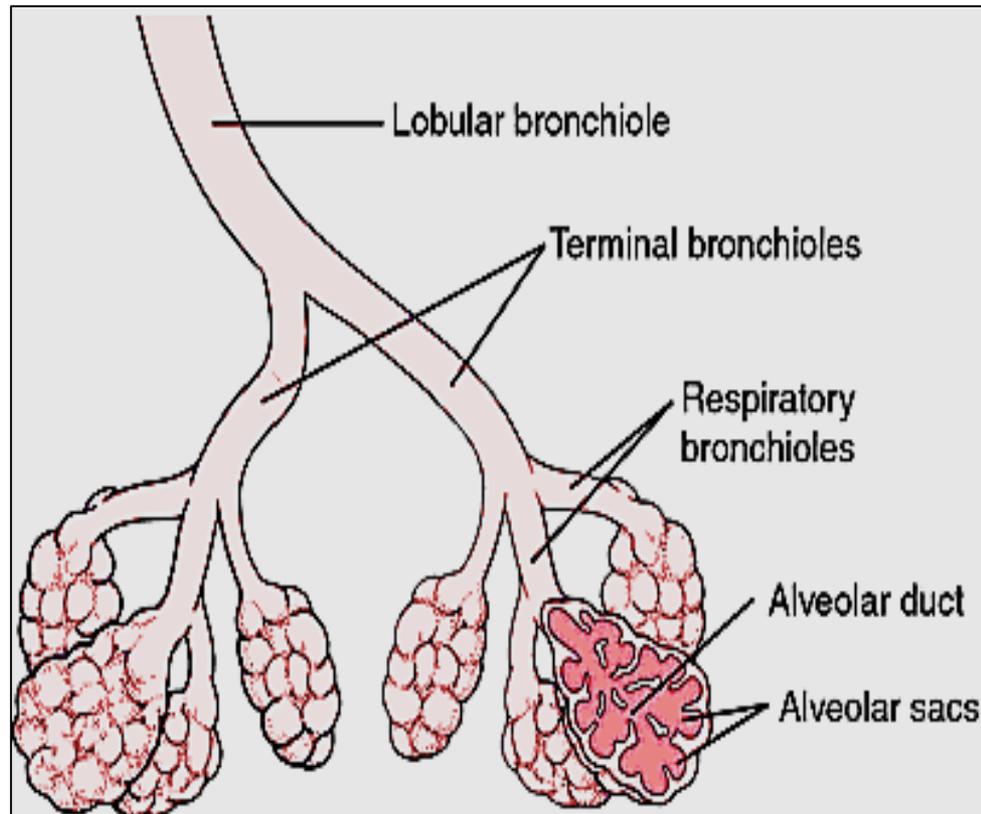


Figure 18.12. Diagram of a Clara cell between bronchiolar ciliated epithelial cells.

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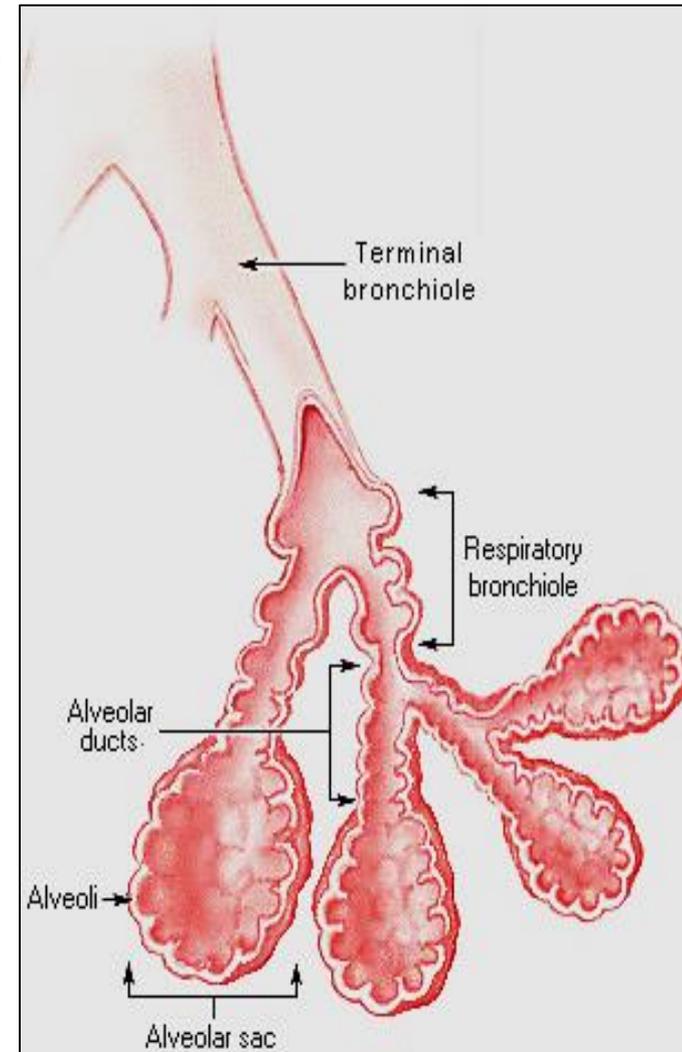
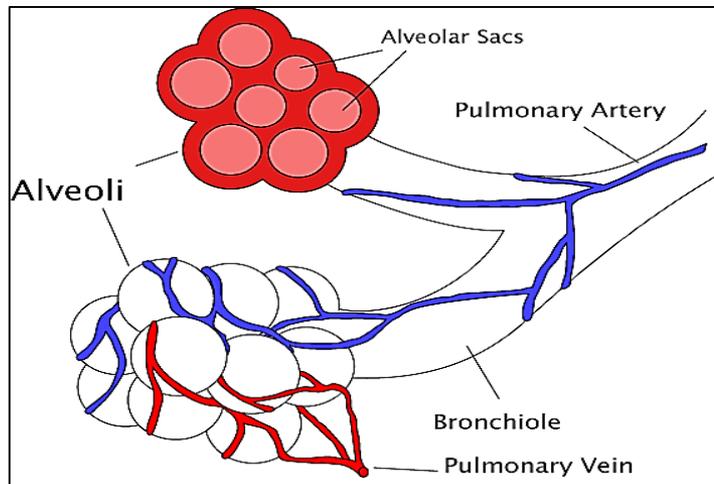
■ Terminal bronchioles:



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

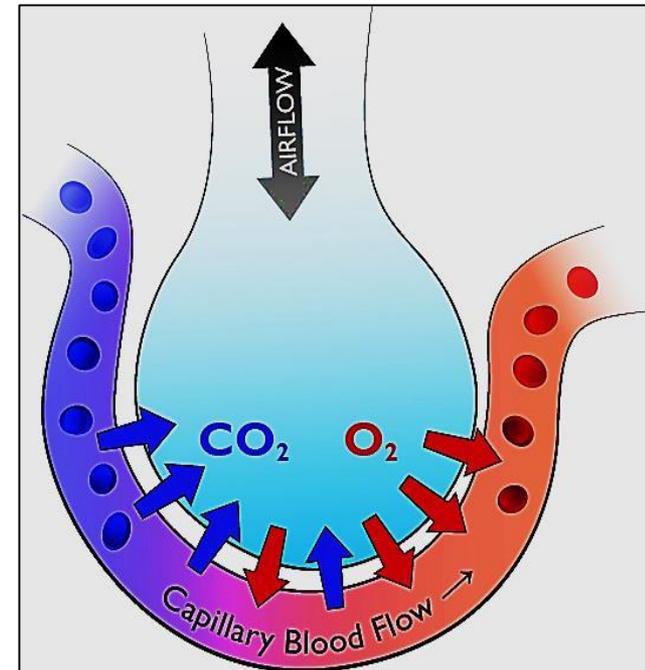
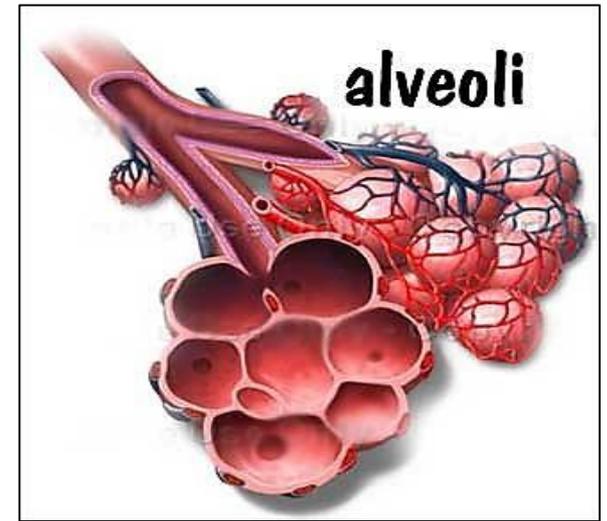
B- respiratory portion

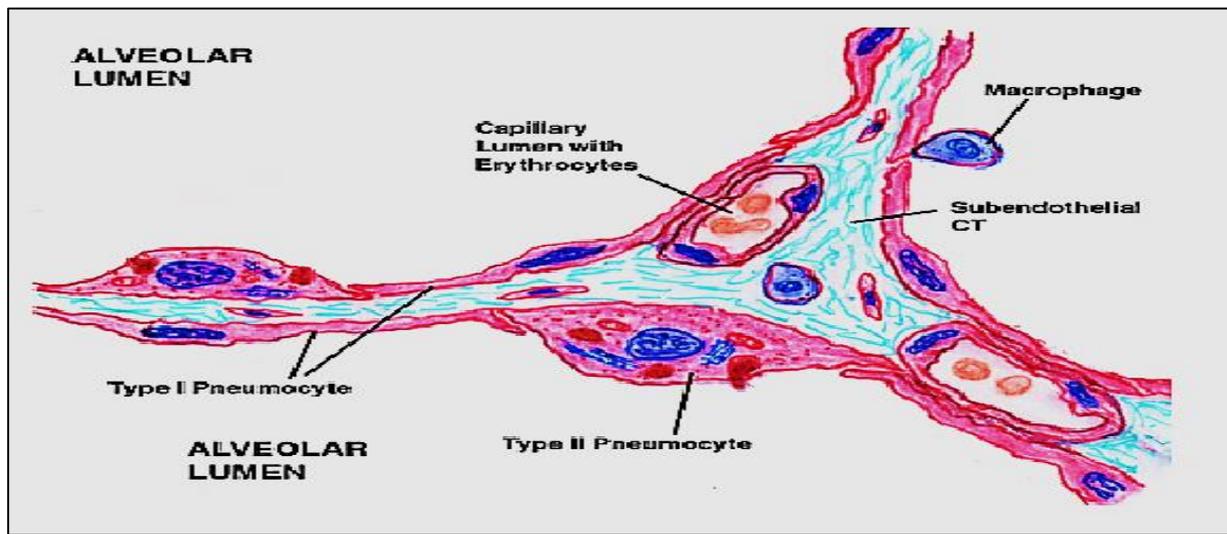
- Is where gas exchange takes place
- Includes:
 - ✓ Respiratory bronchioles
 - ✓ Alveolar ducts
 - ✓ Alveolar sacs
 - ✓ Alveoli



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



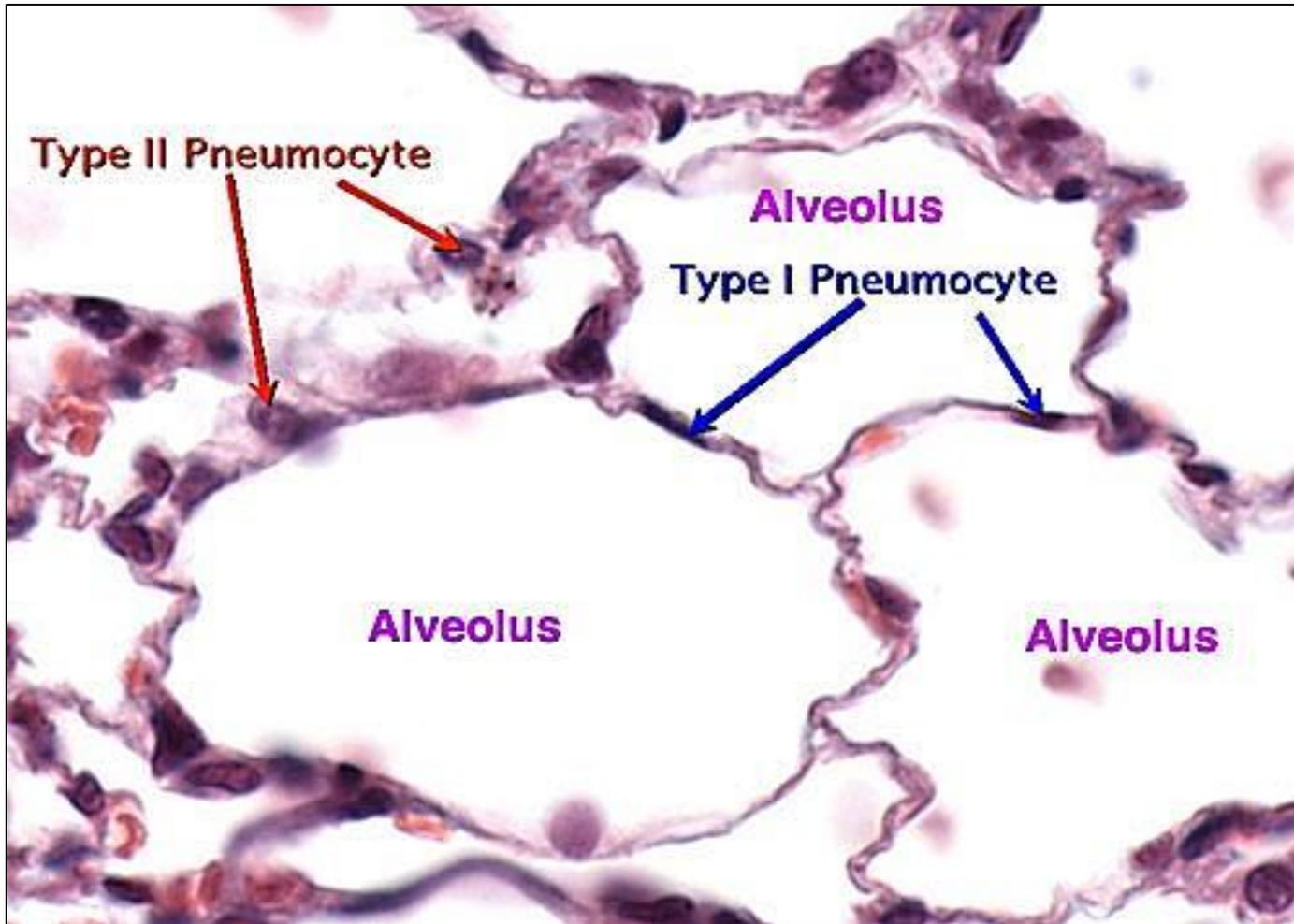


Type I pneumocytes

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

Type II pneumocytes

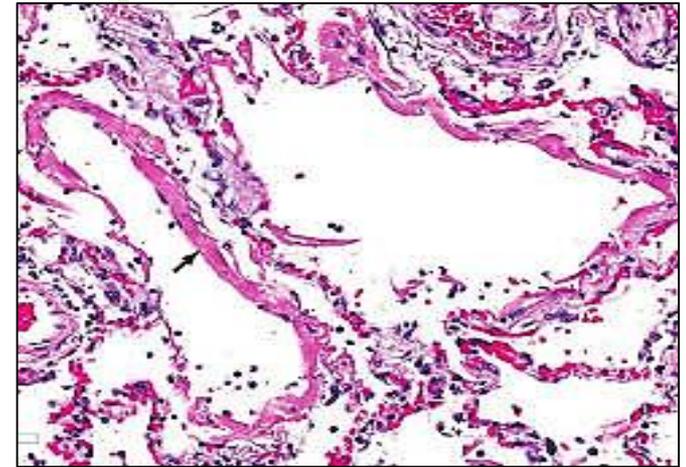
- 3%
- Cuboidal cells e central nuclei & foamy cytoplasm
- Function: Secrete surfactant + stem cells
- Have ACE2 receptors where Covid-19 spikes attack



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

