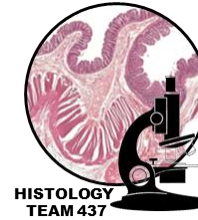




# Lower Respiratory Tract

(Trachea, Bronchi, Bronchioles) & the Lung



**Red: important.**

**Black: in male | female slides.**

**Gray: notes | extra.**

Editing file

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Revised by

## ➤ OBJECTIVES

### 1- The microscopic structures of the wall of:

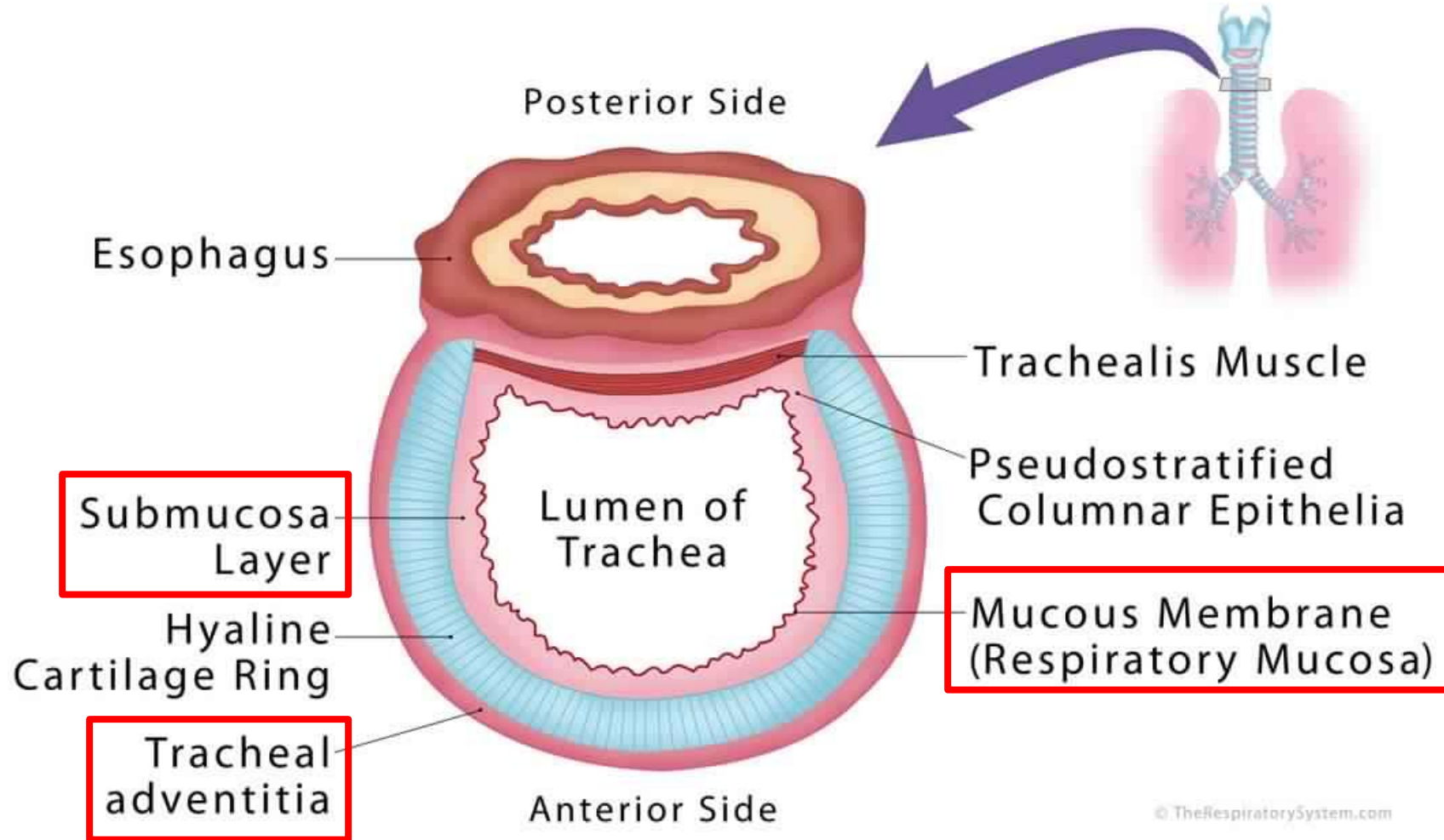
- Trachea.
- Primary or extrapulmonary bronchi.
- Intrapulmonary (secondary and tertiary) bronchi.
- Bronchioles.

### 2- The microscopic structures of:

- Inter-alveolar septum.
- Alveolar phagocytes.
- Pleura.

EXTRA :

# Cross Section of the Trachea



# TRACHEA

The wall of trachea is formed of

## Mucosa

The only mucosa that composed of three layers

**Epithelium** - Respiratory epithelium (pseudo-stratified Ciliated columnar Epithelium with goblet cell)

**Lamina propria**

**Elastic lamina**

It is formed of elastic fibers.  
It separates lamina propria from submucosa

**Connective tissue** (loose connective tissue)

## Submucosa

sub=under

**Numerous mucous & seromucous glands**

Numerous mucous & seromucous glands known as Trachealis gland

**Lymphoid elements**

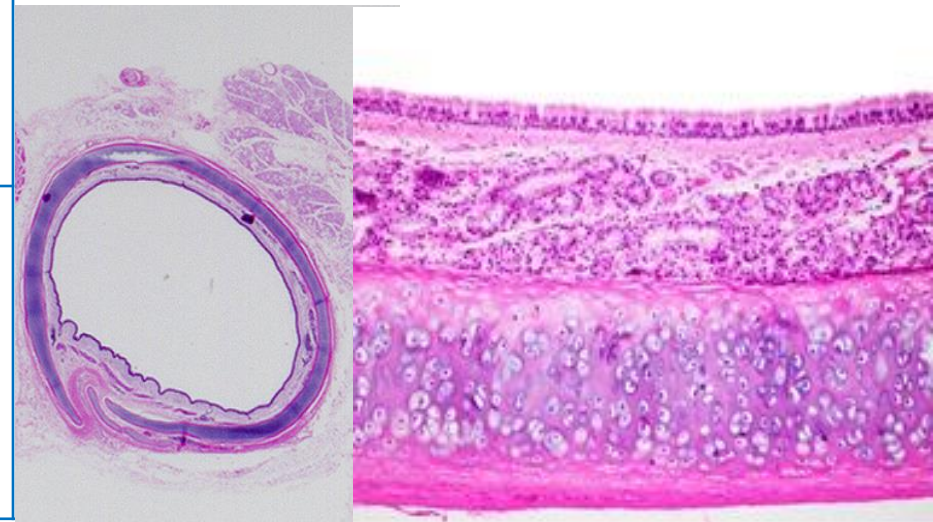
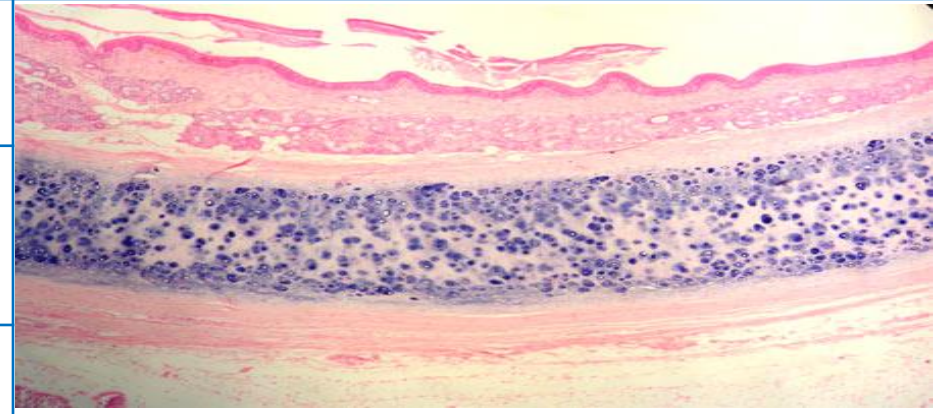
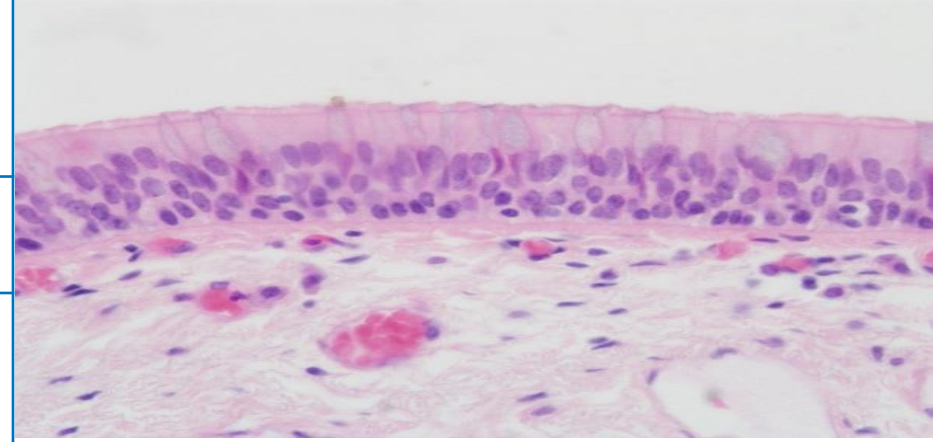
## Adventitia

**Fibroelastic Connective tissue**

**C-shaped rings (12-16) of hyaline cartilage.**

Trachealis muscle (bundle of **smooth muscle fibers**) connects the 2 ends of each C-shaped (**incomplete**) rings of cartilage

Trachealis muscle is smooth muscle and it help in contraction and dilatation of the trachea



## ➤ EXTRAPULMONARY BRONCHUS (1ry BRONCHUS)

Generally have the same histological appearance as the trachea **but** different in diameter.

## ➤ INTRAPULMONARY BRONCHI (2ry & 3ry BRONCHI)

### Mucosa

- A) Epithelium: Respiratory Epithelium
- B) Lamina propria
- N.B. No elastic lamina**

### Muscle coat (complete)

Two distinct layers of smooth muscle fibers spirally arranged in opposite direction.

### Submucosa

#### C.T. contains:

- A) Seromucous glands
- B) Lymphoid elements

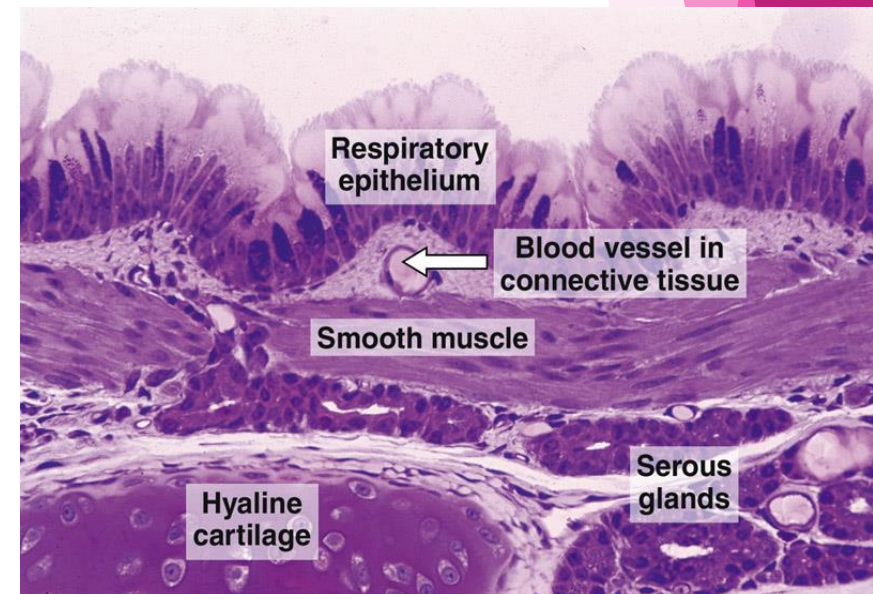
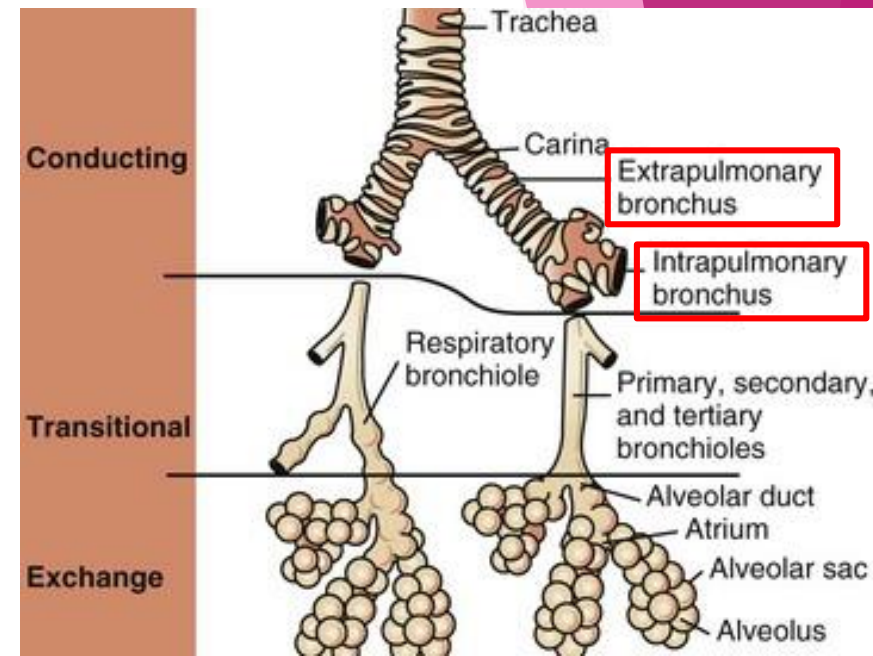
### Adventitia

- A) Loose C.T.
- B) Irregular plates of hyaline cartilage (complete layer)
- C) Solitary lymphoid nodules

### Remember:

trachea & extrapulmonary bronchus have (mucosa, submucosa & adventitia)  
Intrapulmonary bronchus have (mucosa, submucosa, adventitia & Muscle coat)

\* Present of cartilage in trachea and bronchus prevent them from collapse



# BRONCHIOLES

## ➤ BRONCHIOLES

### Preterminal (lobular) ( 1ry ) Bronchioles:

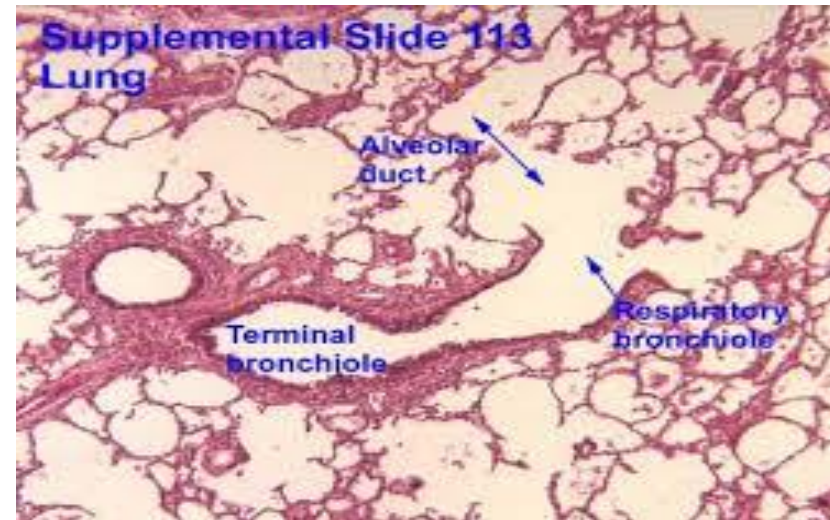
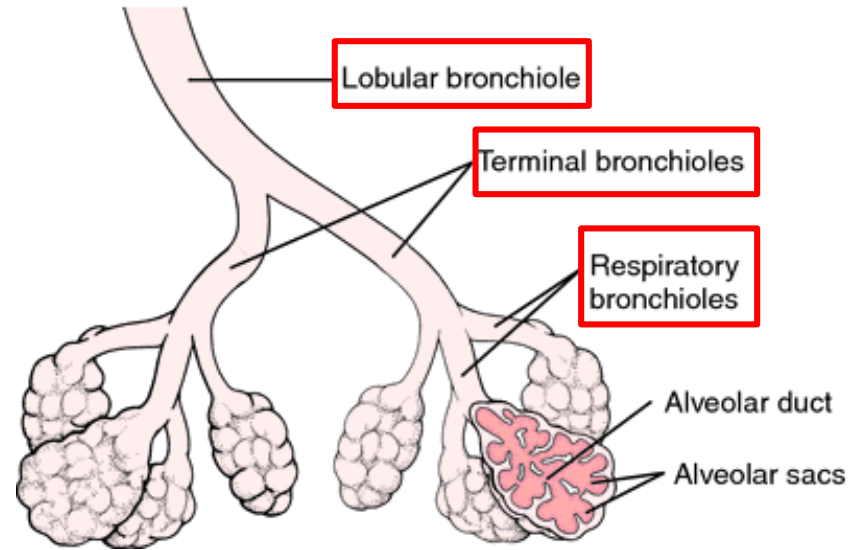
Are less than 1mm in diameter.

### Terminal ( 2ry ) Bronchioles

Are less than 0.5mm in diameter.  
the last part of the conduction zone

### Respiratory ( 3ry ) Bronchioles

the first part of the respiratory zone



Note: don't confuse the Bronchus with Bronchioles.

The difference between the bronchioles and the bronchus is the absent of: Cartilages, Submucosa, Lymph nodules, Goblet cells and Seromucous glands.

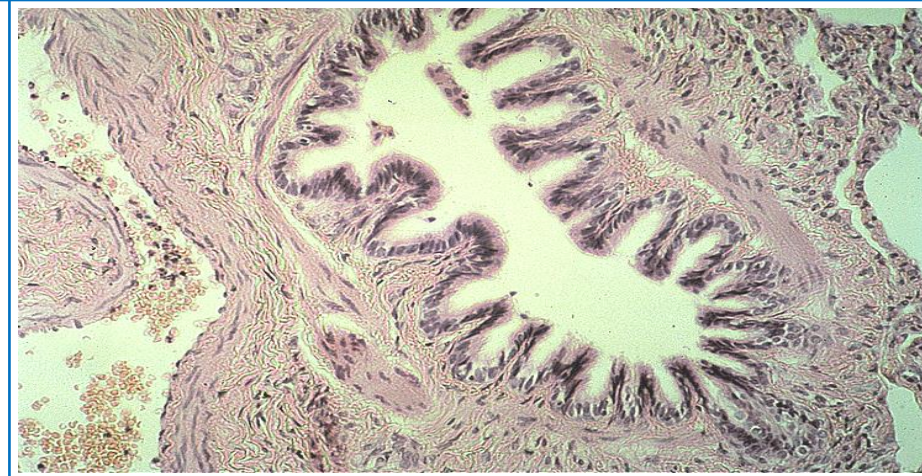


# Bronchioles

## Preterminal Bronchioles

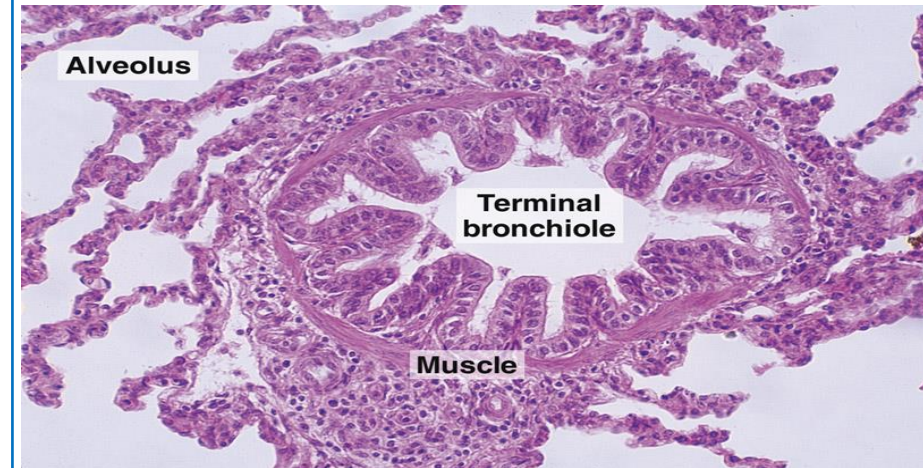
**NOTE:** No cartilage  
No seromucous glands  
No lymph nodules

- 1- Mucosa:** has longitudinal folds:
  - (A) Epithelium:** Simple ciliated columnar Epithelium. **With occasional goblet cells.**
  - (B) Lamina propria:** Connective tissue rich in elastic fibers.
- 2- Smooth muscle:** **2 helically** arranged smooth muscle layers.
- 3- Adventitia:** Connective tissue.



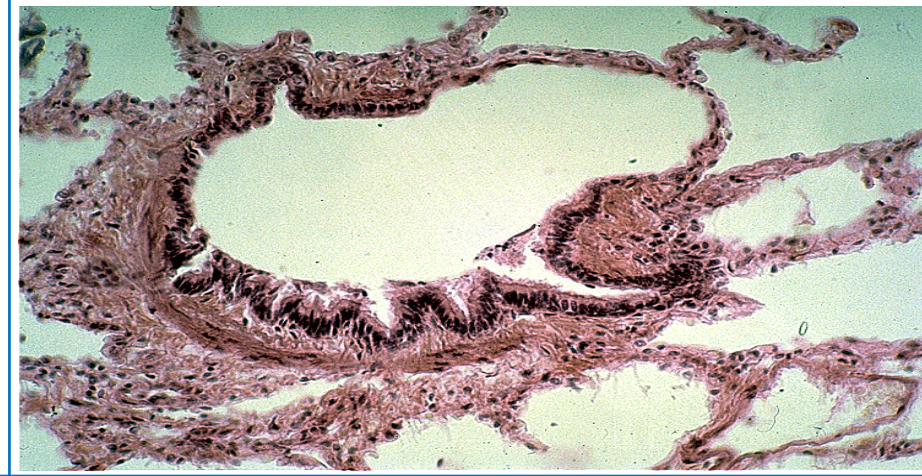
## Terminal Bronchioles

Similar structure to preterminal bronchioles, **BUT:**  
**Epithelium:**  
Simple cuboidal partially ciliated epithelium With **Clara cells**  
**(NO goblet cells)**



## Respiratory Bronchioles

Similar structure to terminal bronchioles, **BUT:**  
their walls are interrupted by the presence of few **pulmonary alveoli.**



## ➤ CLARA CELLS

columnar cells (non ciliated).

### ▶ Function:

- 1- Degrade toxins in inhaled air.
- 2- Divide to regenerate the bronchiolar epithelium.
- 3- Produce surfactant-like material.

Note: found in 2ry & 3ry bronchioles.

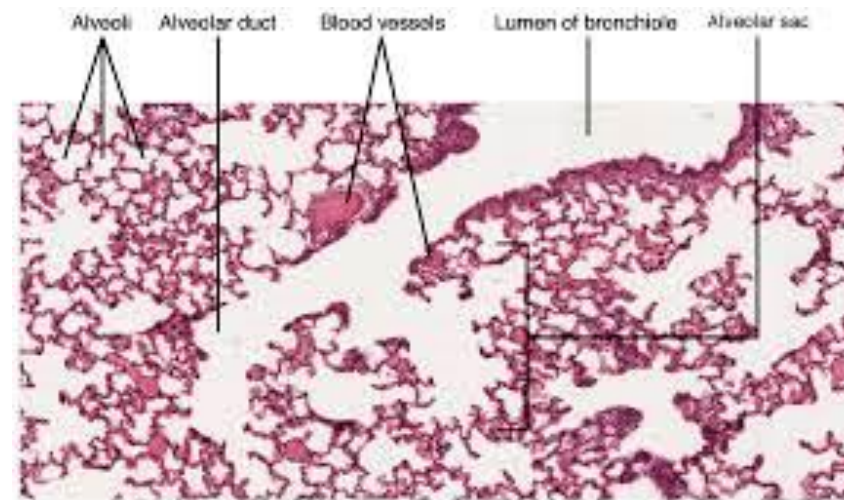
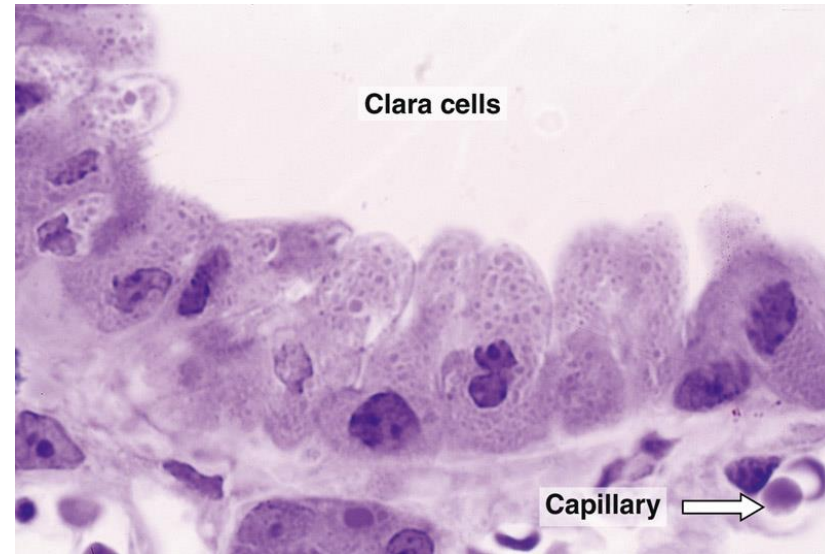
## ➤ ALVEOLAR DUCTS

The wall of alveolar ducts consist almost of pulmonary alveoli.

**Note: Alveolar duct ends by atrium communicates with: 2-3 alveolar sacs**

\* Atrium is 2 or more alveolus opening on each other and it open in alveolar duct.

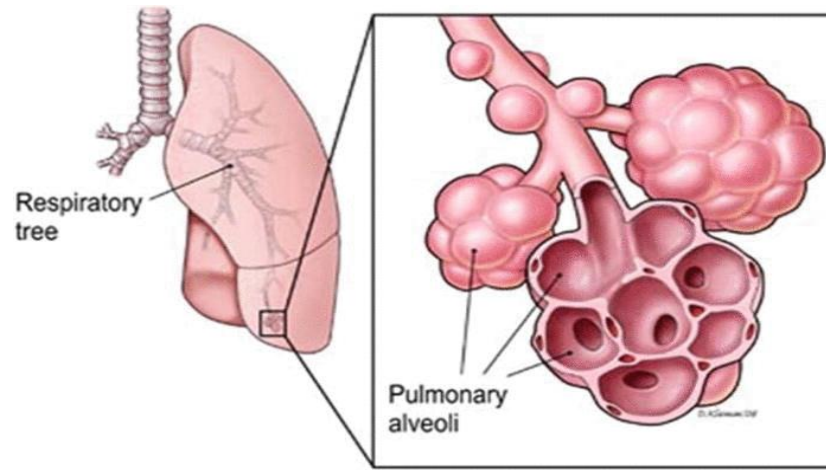
\* Alveolar sac is 2 or more alveolus opening on each other.





## ➤ PULMONARY ALVEOLI

They are small out-pouching of respiratory bronchioles, alveolar ducts & alveolar sacs.



### PULMONARY ALVEOLI

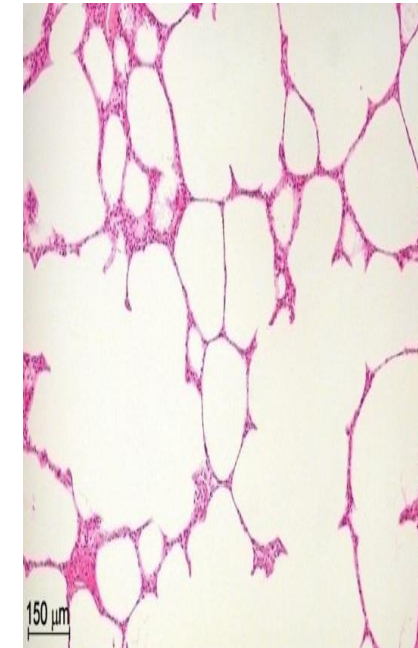
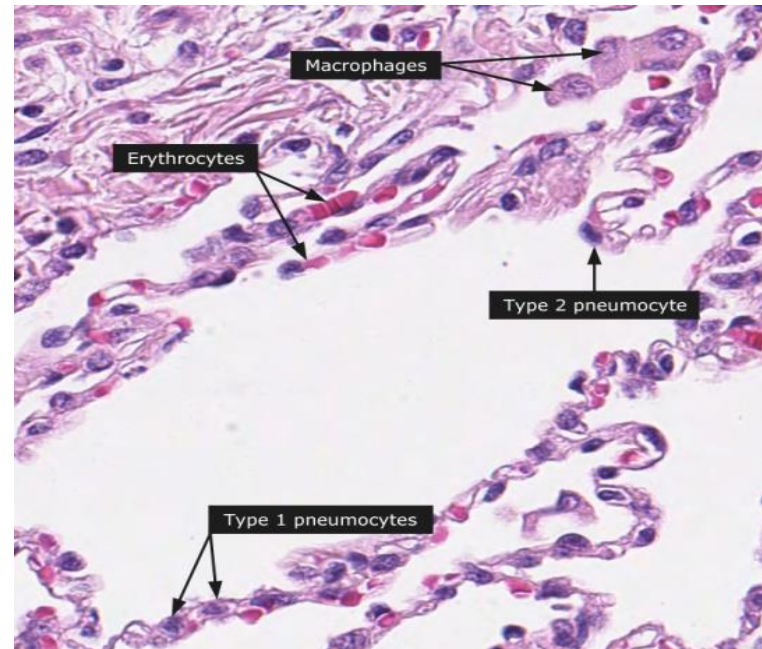
#### Alveolar epithelium

lines both sides of interalveolar septum

#### Interalveolar septa

The region between 2 adjacent alveoli

#### Alveolar phagocytes (Lung macrophages)



Note: the number of elastic fibers increase as we go deeper



# INTERALVEOLAR SEPTA

## Alveolar Epithelium

**Type I Pneumocytes**  
(blue arrows)

- **line 95%** of the alveolar surface.
  - Are **less numerous** than type II pneumocytes.
  - L/M: simple squamous epithelium.
- Function:**
- Exchange of gases.

**Type II Pneumocytes**  
(green arrows)

- **Line 5%** of the alveolar surfaces.
  - Are **more numerous** than type I pneumocytes.
  - Are cuboidal or rounded cells, With **Foamy cytoplasm**.
- Nucleus: central & rounded.  
-The cytoplasm contains membrane-bound **Lamellar bodies** (contain pulmonary surfactant).

\* Have less surface area than Type I but more number of cells

\* It looks like foam because it has a lot of vesicles that contain surfactant

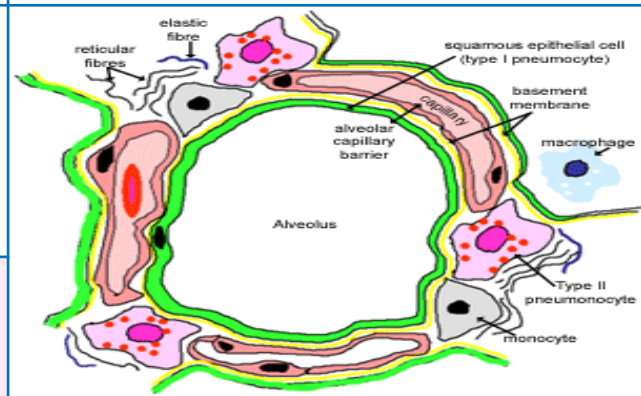
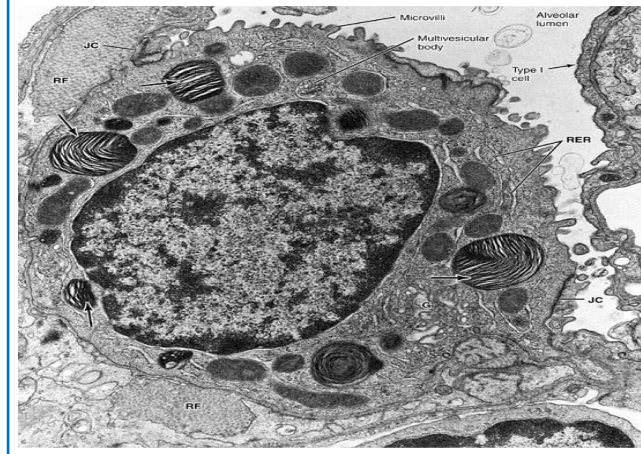
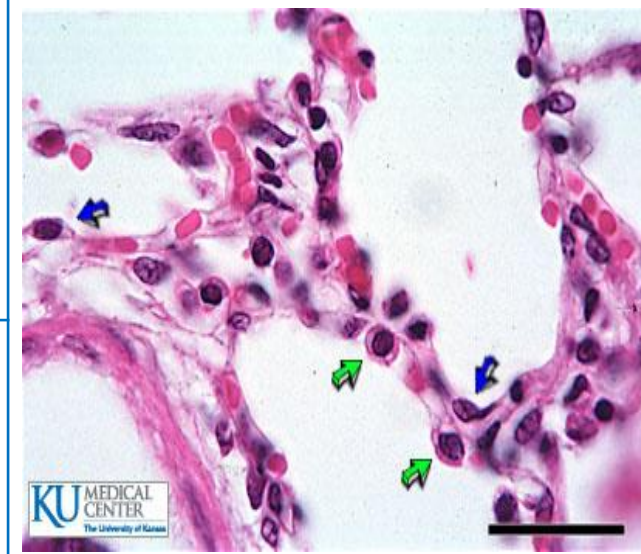
- Function:**
- 1- Synthesis & secretion of **pulmonary surfactant**.
  - 2- Renewal of alveolar epithelial cells: Type II cells can divide to regenerate both type I & type II pneumocytes.

**Interstitial**  
Pulmonary Capillaries is Continuous and it has thick basement membrane to prevent any toxic materials inter the circulation

**Interstitial connective tissue**

**C.T. Fibers:** elastic fibers & type III collagen (reticular fibers).  
**C.T. Cells:** Fibroblasts, Macrophages, Mast cells, Lymphocytes.

## Continuous Pulmonary Capillaries



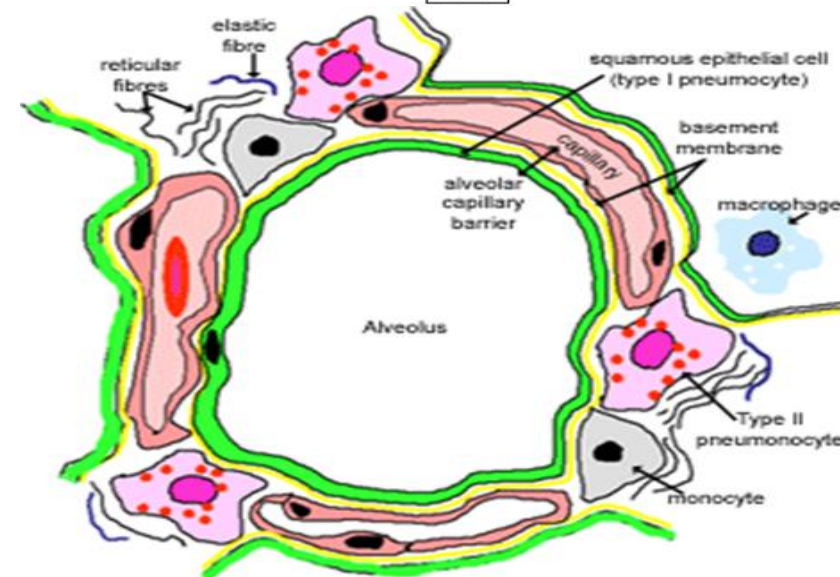
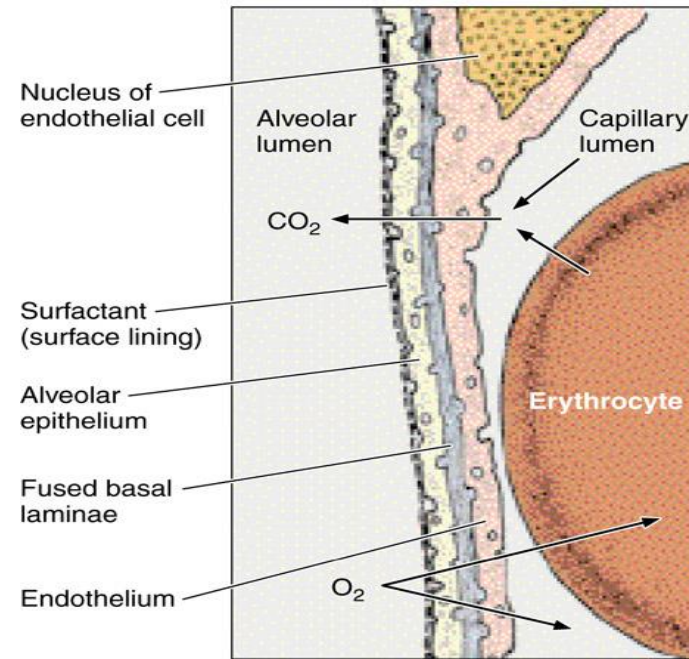
## ➤ BLOOD-GAS BARRIER = (BLOOD-AIR BARRIER)

It is the region of the interalveolar septum that is traversed by O<sub>2</sub> & CO<sub>2</sub>.

Note: the O<sub>2</sub> molecules will pass through these 4 structures respectively to diffuse from Alveoli to the capillaries.

### Components:

- 1- Thin layer of surfactant.
- 2- **Type I pneumocyte.**
- 3- Fused basal laminae of **type I pneumocytes** & endothelial cells of the pulmonary capillary.
- 4- Endothelial cells of the pulmonary capillary.



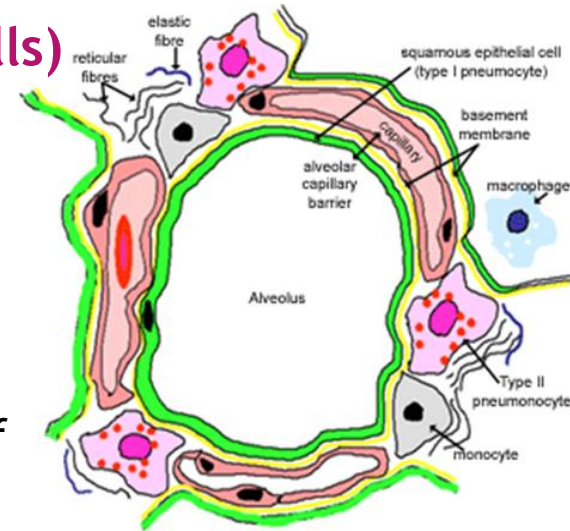
➤ **Alveolar phagocytes = (Alveolar Macrophages) = (Dust Cells)**

○ **Sites:**

- 1- In the lumen of pulmonary alveoli.
- 2- In the interstitium of interalveolar septa.

○ **Function:**

Phagocytose particulate matter (e.g. dust) & bacteria in the lumen of pulmonary alveoli and in the interstitium of interalveolar septa.



➤ **Pleura**

**Is formed of two layers:**

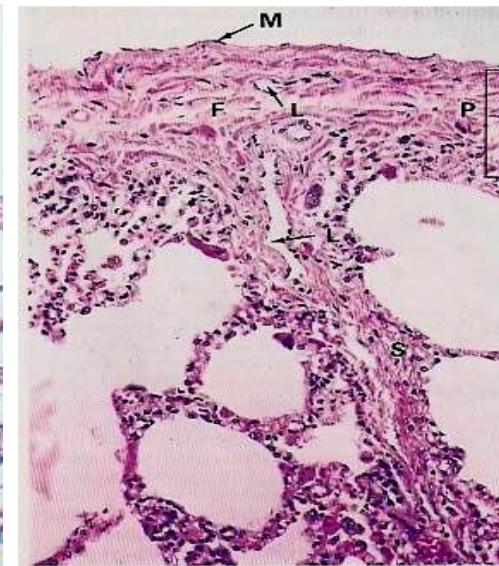
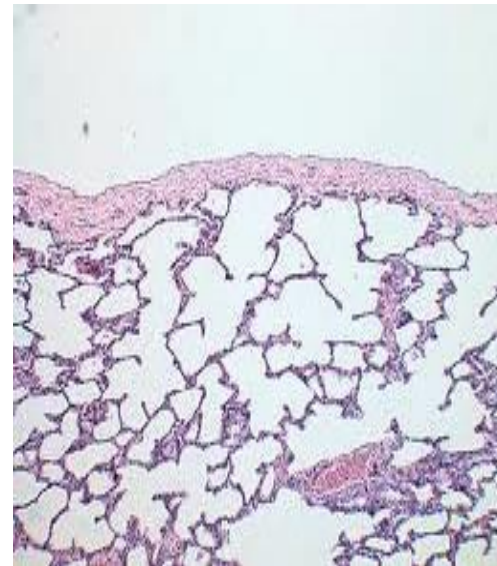
- **Parietal and visceral.**

It is formed of **simple squamous mesothelium**.

The two layers are separated by serous fluid.

**The visceral layer has sub-epithelium loose**

**C.T.** that extends into the lung tissue



➤ **QUESTIONS:**

**Q1: What type of tissue forms the alveoli in the lung?**

- A) Simple squamous epithelium
- B) Stratified squamous epithelium
- C) Simple cuboidal epithelium
- D) Pseudostratified epithelium

**Q2: What is the first portion of the respiratory tree where gas exchange can occur?**

- A) Alveolar sac
- B) Terminal bronchiole
- C) Respiratory bronchiole
- D) Alveoli

**Q3: In which structure gas exchange does not occur?**

- A) Alveolar sac
- B) Terminal bronchiole
- C) Respiratory bronchiole
- D) Alveoli

**Q4: Which one of the following has an elastic lamina?**

- A) preterminal bronchioles
- B) Terminal bronchioles
- C) extrapulmonary bronchi
- D) trachea

**Q5: Type of muscle coat found in intrapulmonary bronchus is?**

- A) Cardiac muscle
- B) Skeletal muscle
- C) Smooth muscle
- D) all of them

**Q6: How many layer pleura composed of?**

- A) One layer
- B) two layers
- C) three layers
- D) four layers

B -9  
C -5  
D -4  
B -3  
C -2  
A -1



**Q7: Preterminal Bronchioles is?**

- A) Are less than 1mm in diameter
- B) Are less than 0.5 mm in diameter
- C) Are more than 1mm in diameter
- D) Are less than 0.1 mm in diameter

**Q8: Pleura is formed of layers?**

- A) Simple squamous mesothelium
- B) Stratified squamous epithelium
- C) Simple cuboidal epithelium
- D) Pseudostratified epithelium

**Q9: Which one of the following is responsible for the secretion and synthesis of pulmonary surfactant?**

- A) Type I pneumocytes
- B) Type II pneumocytes
- C) Alveolar ducts
- D) Trachea

**Q10: Which type of cartilage is found in the trachea?**

- A) Elastic cartilage
- B) Fibrocartilage
- C) Hyaline cartilage
- D) Have no cartilage

**Q11: What type of cartilage is found in the Preterminal Bronchioles?**

- A) Elastic cartilage
- B) Fibrocartilage
- C) Hyaline cartilage
- D) Have no cartilage

**Q12: Degrade toxins in inhaled air is function of?**

- A) Clara cells
- B) Alveolar ducts
- C) Pleura
- D) Type I Pneumocytes

12-A  
11-D  
10-C  
9-B  
8-A  
7-A



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