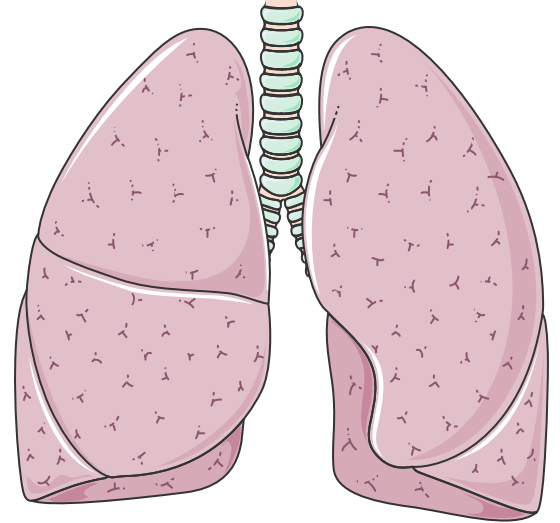


Histology of Lower tract

Color index:

- Main text -Important -Notes
- Boys' slides -Girls' slides -Extra



Editing file

Objectives

By the end of this lecture, you should be able to describe: :3

01

The microscopic structure of the wall of:

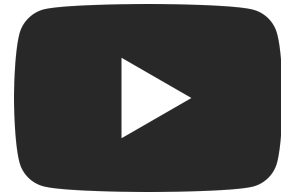
- Intrapulmonary (secondary and tertiary) bronchi.
- Bronchioles.

02

The microscopic structure of:

- Inter-alveolar septa & blood-air barrier.
- Alveolar macrophages.
- Pleura.

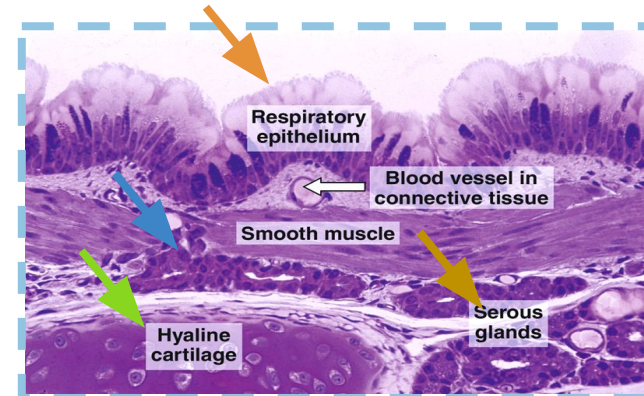
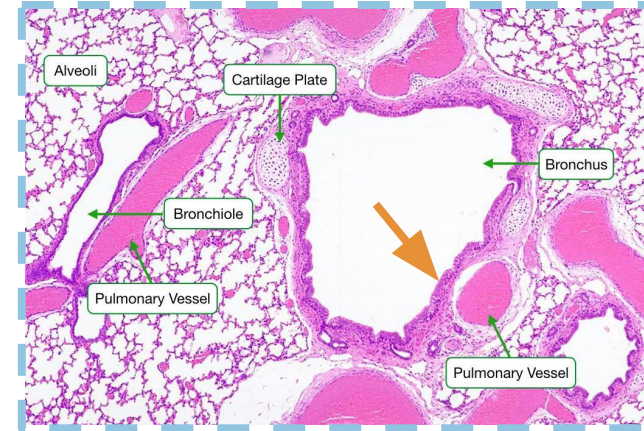
For better
understanding
watch this video

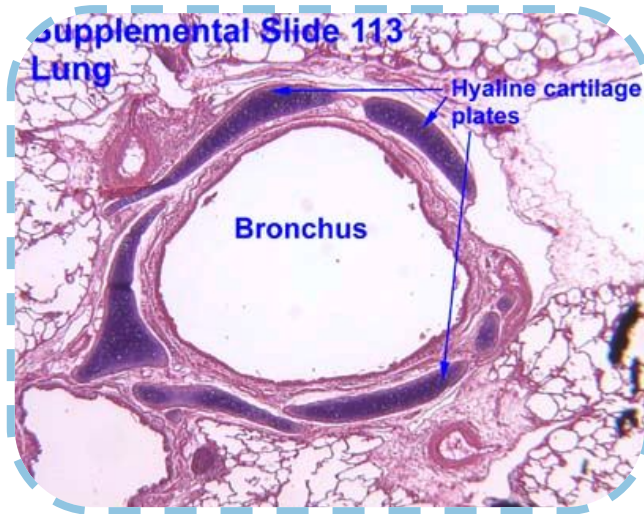


Intrapulmonary Bronchi (2ry & 3ry BRONCHI)

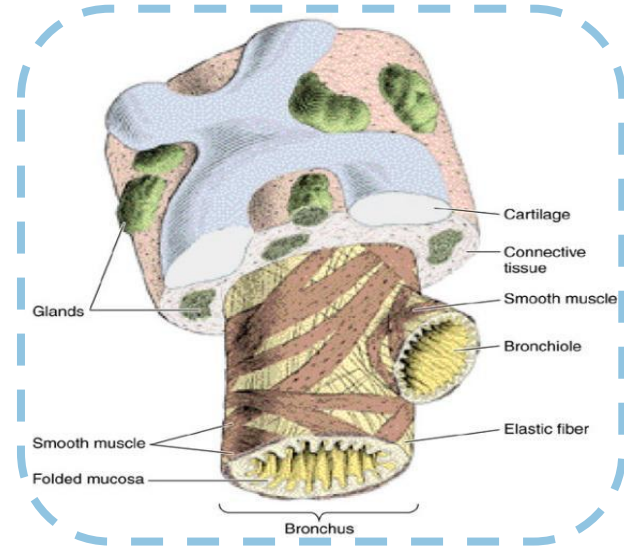
The wall is formed of 4 layers:

Mucosa	Epithelium: Respiratory epithelium. (pseudostratified columnar epithelium ciliated with goblet cells)
	Lamina propria: Fibroelastic CT with seromucous glands & lymphoid elements. N.B. No elastic lamina. (why? 'Cuz there is layer of muscle instead)
Muscle coat (Not in trachea)	Two distinct layers of smooth muscle fibers arranged spirally in opposite Direction. (complete layer)
Submucosa Fibroelastic CT With:	1- Seromucous glands . 2- Lymphoid elements.
Adventitia Fibroelastic CT With :	1- Irregular plates of hyaline cartilage . (complete layer) (most prominent structure) 2- Solitary lymphatic nodules.





The hyaline cartilage is not a whole piece but forms an entire layer.



When muscles contract of the muscle coat does the bronchus close completely?
No, because of the presence of cartilage. (allow air to pass)

How do we know that this is bronchioles?

1- NO cartilage

2- Diameter

Bronchioles

Preterminal Bronchioles

Diameter is less than 1mm (1ry)

Mucosa: has longitudinal folds:

1- **Epithelium:** Simple columnar ciliated epithelium with occasional goblet cells + clara cells.

(not pseudostratified)

2- **Lamina propria:** Fibroelastic CT with NO glands.

Muscle coat:

Two spirally arranged smooth muscle layers.

Adventitia: Fibroelastic CT.

N.B. The walls of bronchioles have:

- No cartilage
- No seromucous glands
- No lymph nodules
- No submucosa.

Terminal Bronchioles

Diameter is less than 0.5 (2ry)

Similar structure to pre-terminal bronchioles, but two differences at epithelium:

- Simple cuboidal partially ciliated epithelium.

- With Clara cells (NO goblet cells).

Will be clarified in next slides.

1- we call it terminal because it's the terminal end of the conduction portion.

2- last point for goblet cells.

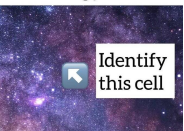
Respiratory Bronchioles

have alveoli in their walls (3ry)

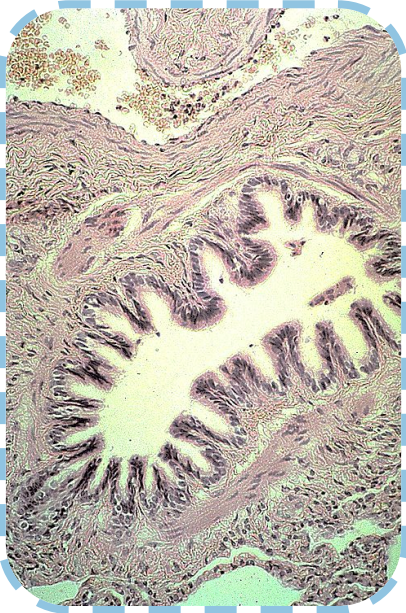
Similar structure to terminal bronchioles but:

Their walls are interrupted by the presence of few pulmonary alveoli.

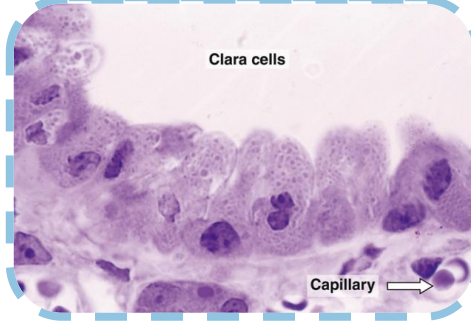
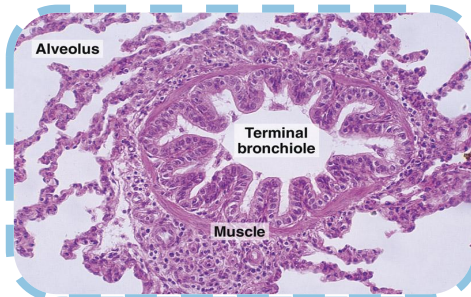
Are the first region of the respiratory system where gas exchange can occur.



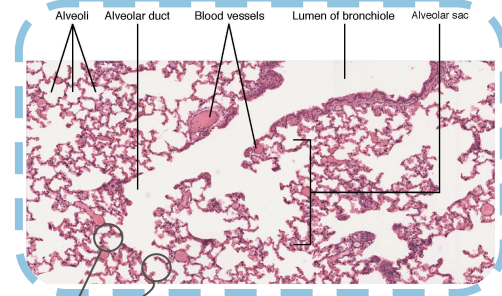
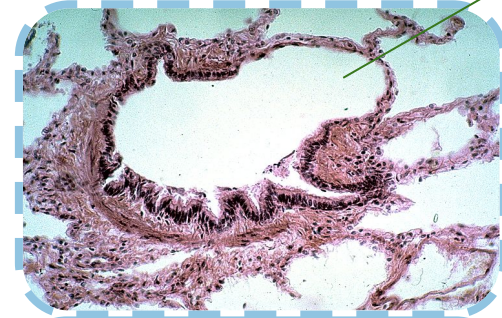
P Preterminal bronchioles



T Terminal bronchioles



R Respiratory bronchioles



atrium

Air sac

Clara (Club) cells

What are they?

- **Columnar cells (non-ciliated).**
- with dome-shaped apices (Plural of Apex) protruding into the lumen.

What do they have?

- Numerous apical (Adj. of Apex) secretory granules and apical SER.
- Apical tight junctions.
- Abundant RER. (for secretions)

Their Functions:

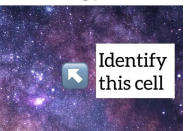
- Degrade toxins in inhaled air in their SER.
- **Divide to regenerate the bronchiolar epithelium.** (As stem cells not just for clara)
- **Produce surfactant-like material.**

Pulmonary Alveoli

- Pulmonary alveoli are small, cup-shaped outpocketings of respiratory bronchioles, alveolar ducts, and alveolar sacs (air sacs).
- Alveoli are separated from each other by interalveolar septa.**

Alveolar Ducts

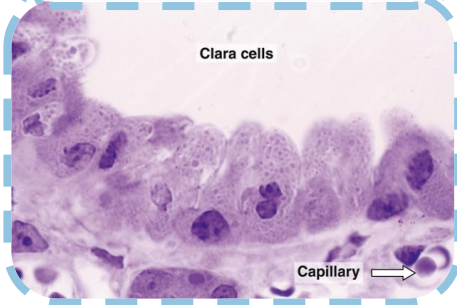
- The wall of alveolar ducts consists almost entirely of pulmonary alveoli.
- Each alveolar duct ends by an **atrium** in which 2-3 alveolar sacs open.



Identify this cell

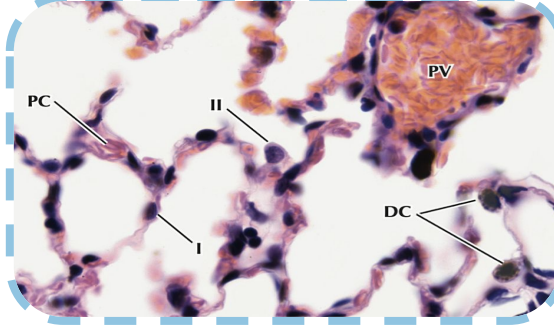
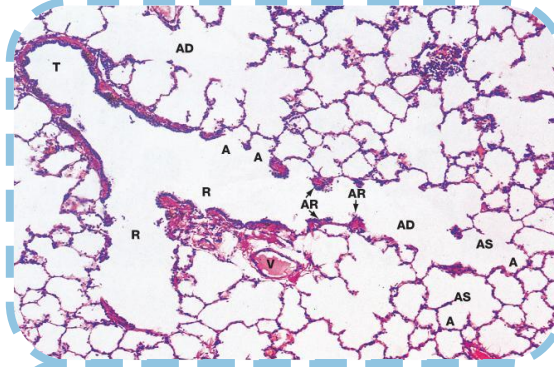
1

Clara



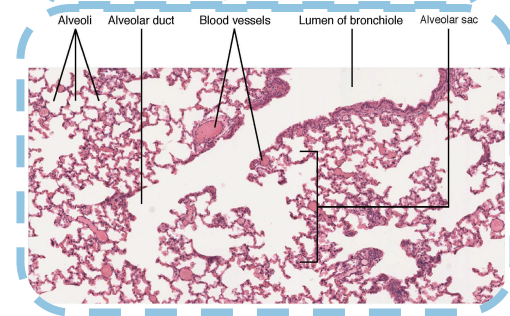
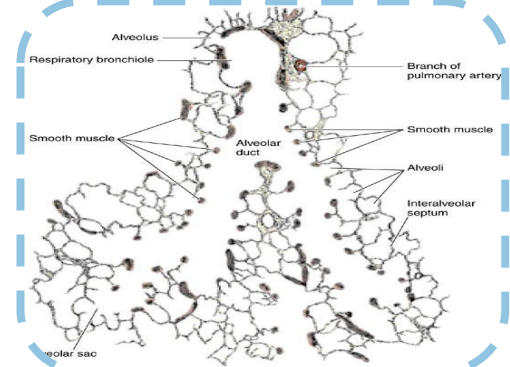
2

Pulmonary Alveoli



3

Alveolar ducts

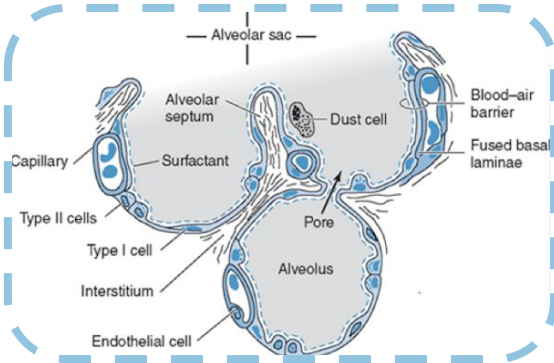


**Interalveolar septa
(The region between two adjacent alveoli)**

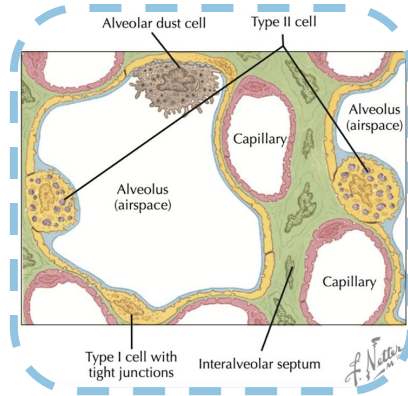


<p>Alveolar epithelium (lines both sides of interalveolar septum)</p>	<p>Type I pneumocytes (Type 1 alveolar cells)</p>	<ul style="list-style-type: none">* Line 95% of the alveolar surface.* Less numerous than type II pneumocytes. (Why? Because it's larger and occupies large space)* L/M: Simple squamous epithelium.* E/M: Attenuated cytoplasm with few organelles. Tight junctions with each other.* Well-developed basal lamina.* Function: Exchange of gases. (flat cells)
<p>Interstitial</p>	<p>Type II pneumocytes (Type II alveolar cells)</p>	<ul style="list-style-type: none">* Line 5% of the alveolar surfaces.* More numerous than type I pneumocytes. (Why? Because it's smaller)* L/M: Cuboidal cells, with dome-shaped apices, central round nucleus, & foamy cytoplasm.* E/M: Abundant RER(because it's secretory organelles) , well-developed Golgi, & mitochondria. Membrane-bound lamellar bodies (contain pulmonary surfactant).* Functions:<ul style="list-style-type: none">- Synthesis & secretion of pulmonary surfactant which decreases surface tension thus preventing collapse of alveoli (atelectasis)- Renewal of alveolar epithelial cells: They divide by mitosis to regenerate both type I & type II pneumocytes.
		<ul style="list-style-type: none">* Continuous Pulmonary Capillaries: The richest network of blood capillaries all-over the body.* Interstitial CT: CT Fibers: Elastic fibers + Reticular fibers (type III collagen). (If there was a collagen type 1 (abnormal) it mean that there is fibrosis and dead lung cells)CT Cells: Fibroblasts, Macrophages(rich), Mast Cells, Lymphocytes.

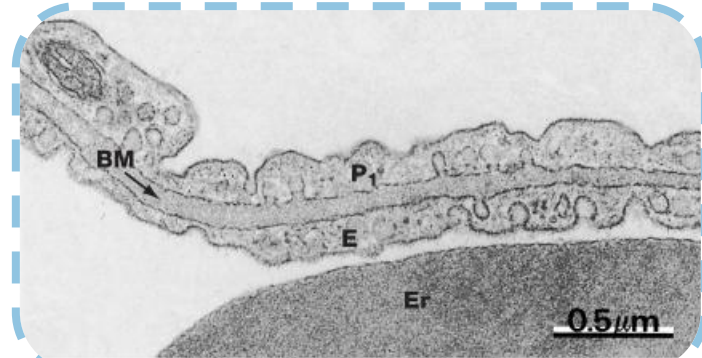
Interalveolar Septa



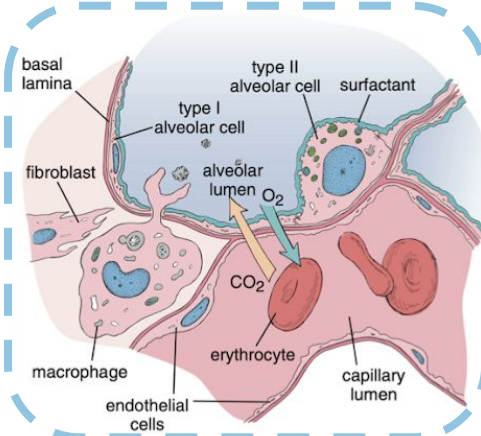
Alveolar Epithelium



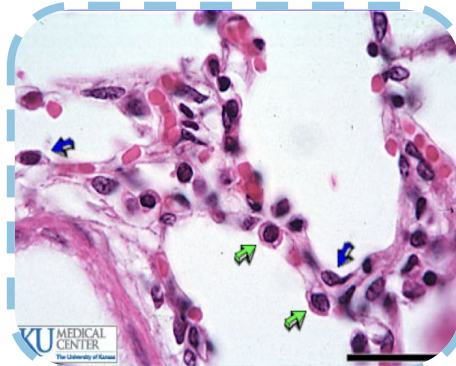
Type 1 pneumocytes



Interstitial of Interalveolar

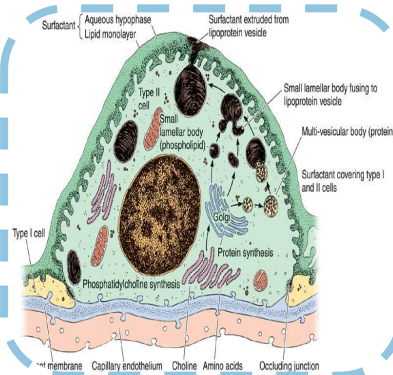
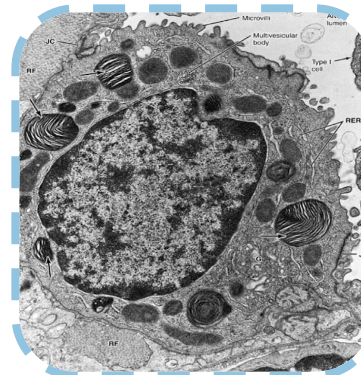


Alveolar Epithelium



Blue -> type 1 pneumocyte
 Green -> type 2 pneumocytes
 * Notice the shape *

Type 2 pneumocytes



Blood- gas barrier (Blood-air barrier)

What is it?

the region of interalveolar septum that is traversed by O₂ & CO₂.

Also known as:
alveolar-capillary barrier

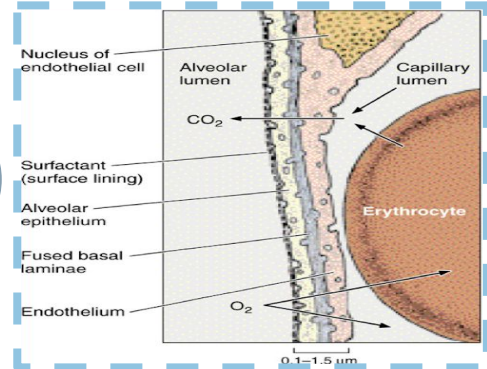
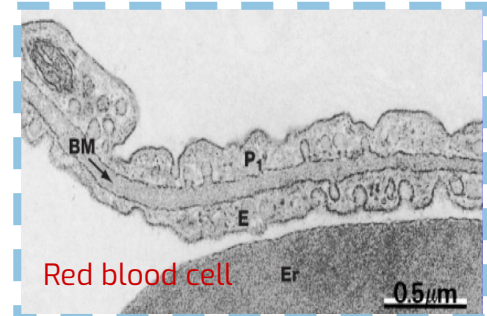
Composed of

Thin layer of
surfactant

Type I
pneumocyte

Fused basal laminae of
type I pneumocytes and
endothelial cells of the
pulmonary capillary

Endothelial cells of the
pulmonary capillary



Alveolar Macrophages

Derived from blood monocytes.

Also called 'dust cells'

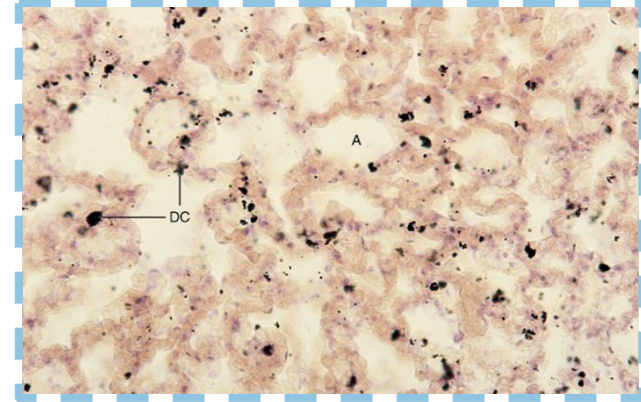
443: (Because dust enters the lung the most)

Sites:

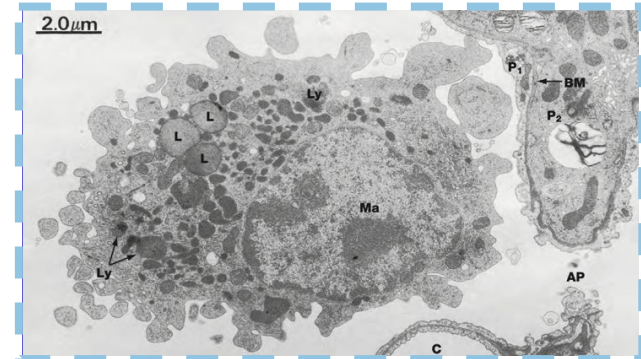
- In the lumen of pulmonary alveoli.
- In the interstitium of interalveolar septa.

Function:

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



هي الحبيبات اللي كأنها غبار



Pleura

It is a serous membrane (producing serum) formed of two layers, **visceral** and **parietal**:

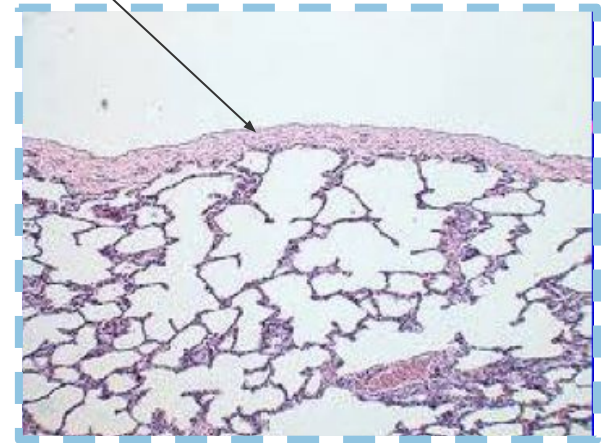
- **The visceral pleura** covers and adheres to the lung. (داخلية)
- **The parietal pleura** lines and adheres to the walls of the thoracic cavity. (خارجية)

The space between the two layers is called the **pleural cavity** and contains serous fluid (permits frictionless movement of the lungs).

- It is composed of **simple squamous mesothelium**.
- The visceral layer has subepithelial loose CT that extends into the lung tissue.

(epithelium is called mesothelium in serous membrane)

Pleura



Bronchi summary

Intrapulmonary Bronchi

Mucosa:

- 1- Respiratory epithelium.
- 2- **Lamina propria: Fibroelastic CT with seromucous glands.**

Muscle coat:

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

Submucosa:

- Fibroblastic CT with:**
- 1- Seromucous glands.
 - 2- Lymphoid elements.

Adventitia:

- Fibroblastic CT containing:**
- 1- Irregular plates of hyaline cartilage.
 - 2- Solitary lymphatic nodules.

Bronchioles

Preterminal <1mm (1ry):

Mucosa: has longitudinal folds;

1- **Epithelium:** Simple columnar ciliated epithelium with occasional goblet cells & Clara cells.

2- **Lamina propria:** Fibroelastic CT with NO glands.

Muscle coat: Two spirally arranged smooth muscle layers.

Adventitia: Fibroelastic CT.

- 1- No cartilage
- 2- No seromucous glands
- 3- No lymph nodules
- 4- No submucosa

Terminal <0.5mm(2ry):

Same as preterminal but has:

- 1- Simple **cuboidal** partially ciliated epithelium.
- 2- With Clara cells (NO goblet cells).

Respiratory (3ry):

- Similar structure to terminal but:

Their walls are interrupted by the presence of few **pulmonary alveoli**.

- Are the first region of the respiratory system where **gas exchange can occur**.

Clara cells

Columnar cells (non-ciliated) with dome-shaped apices, Has:

- 1- granules and apical SER.
- 2- Apical tight junctions.
- 3- Abundant RER.

Functions:

- 1- Degrade toxins in air in SER.
- 2- regenerate the bronchi epithelium.
- 3- Produce surfactant-like material.

Pulmonary Alveoli

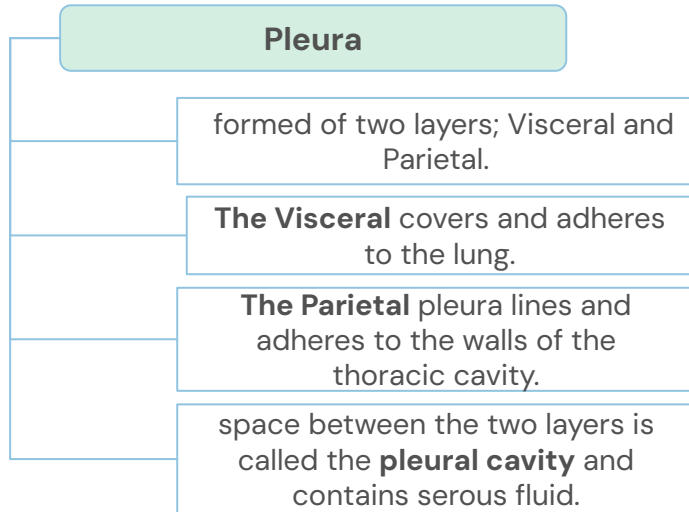
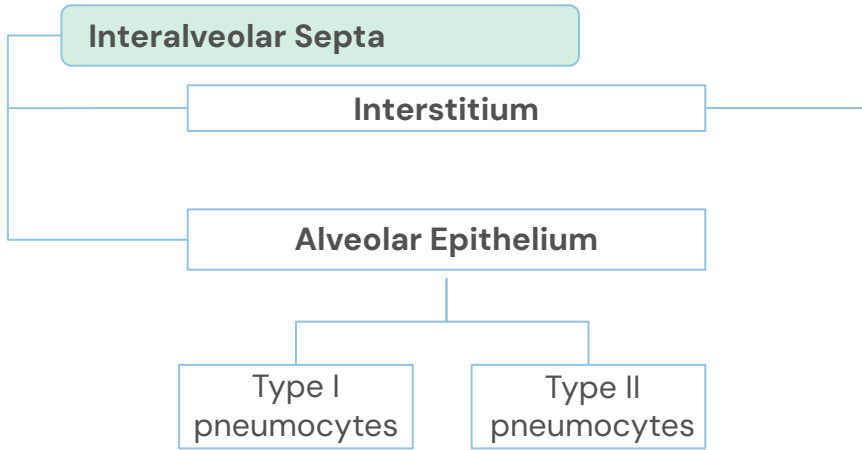
1- are small, cup-shaped outpocketings of respiratory bronchioles, alveolar ducts, and alveolar sacs.

2- Alveoli are separated from each other **by** interalveolar septa.

Alveolar ducts

- 1- The wall of alveolar ducts consists almost entirely of pulmonary alveoli.
- 2- Each alveolar duct ends by an atrium in which 2-3 alveolar sacs open.

Bronchi summary cont



Interstitial:

Continuous Pulmonary Capillaries: The richest network of blood capillaries.

CT Fibers:

- 1-Elastic fibers.
- 2-Reticular fibers (type III collagen).

CT Cells:

- 1-Fibroblasts
- 2- Macrophages
- 3-Mast Cells
- 4-Lymphocytes

Blood- gas barrier

it is the region of interalveolar septum that is traversed by O₂ & CO₂.

Composed of:

- 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 capillaries.

Cells Summary

Type I pneumocytes

Line 95% of the alveolar surface.

Less numerous than type II.

Simple squamous epithelium.

Attenuated cytoplasm with few organelles

Function: Exchange of gases

well developed basal lamina

Type II pneumocytes

Line 5% of the alveolar surfaces.

More numerous than type I

Cuboidal cells, with dome-shaped apices, central round nucleus, & foamy cytoplasm.

Abundant RER, well-developed Golgi, & mitochondria, lamellar bodies.

Synthesis & secretion of surfactant

Renewal of alveolar epithelial cells

Alveolar Macrophages (Dust Monocyte)

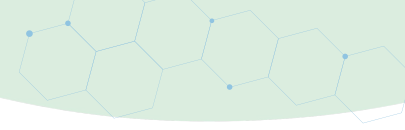
Derived from blood monocytes.

In the lumen of pulmonary alveoli.

In interstitium of interalveolar septa.

Phagocytose inhaled particulate matter like dust.

MCQs:



Q1: What type of cartilage is found in the Pre-Terminal Bronchioles?

A-Elastic cartilage

B- Have No Cartilage

C-Fibrocartilage

D-Hyaline cartilage

Q2: production of surfactant like material is a function of?

A-Pleura

B-Type I
Pneumocytes

C-Clara cells

D-Type II
Pneumocytes

Q3: Exchange of gases is the function of :

A-Type II
Pneumocytes

B-Type I
Pneumocytes

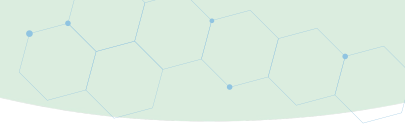
C-Dust cells

D-All of the Above



1-B
2-C
3-B

MCQs:



Q4: The region between 2 adjacent alveoli			
A- Alveolar epithelium	B- Inter-alveolar septa.	C- Alveolar phagocytes	D- Alveolar duct.
Q5: Phagocytosis of particulate matter is the function of			
A- Type I Pneumocytes	B- Type II Pneumocytes	C- Dust cells	D- All The above
Q6: A 54-year-old Female with leukemia undergoes chemotherapy. During treatment, she develops increasing cough and shortness of breath. Sputum cultures are negative, and the patient does not respond to antibiotic therapy. If this patient has acquired a viral pneumonia, with alveolar damage, which of the following cells can regenerate the alveolar epithelium during healing?			
A- Clara cells	B- Enterochromaffin cells	C- Type I pneumocytes	D- Type II pneumocytes



- 4- B
- 5- C
- 6- D

HISTOLOGY TEAM



Abdullah Muhanna



Huda Bassam



Ahmad Addas



Lama AlRasheed



Waleed AlAnazi



Jana AlAhaideb



Abdulaziz AlObathani



Shadin AlAbbas



Rahaf AlDawood