



Respiratory system

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Why?
tell me
why!



Respiratory tract

- 1- Functional classification of the respiratory tract.
- 2- Structure of Larynx.
- 3- Structure of trachea.
- 4- Structure of Bronchi.
- 5- Structure of Bronchioles.
- 6- Structure of alveoli.
- 7- Components of Blood air barrier.
- 8- Structure of pleura.
- 9- Structure of fetal lung.

Respiratory tract

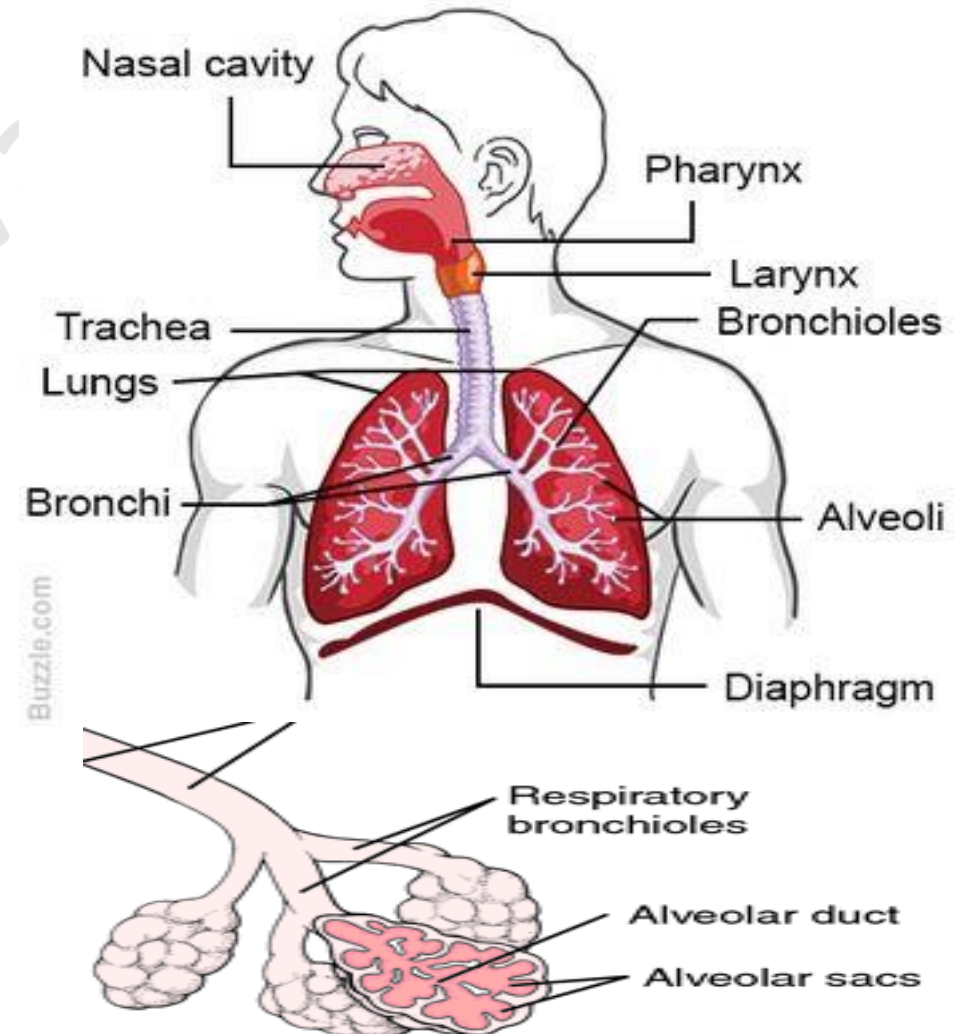
- It consists of two portions:

A- Conducting portion (proximal portion):

- **Function:** conducts the air from the exterior to the respiratory portion & conditioning it.
- It includes the nasal cavity, nasopharynx, the larynx, the trachea, bronchi and terminal bronchioles.

B- Respiratory portion (Distal portion):

- **Function:** exchange of gas between the blood and the air.
- It includes the respiratory bronchioles, alveolar ducts and alveoli.



A- Conducting portion

1-Respiratory mucosa

- **Site:** Covers most of the nasal cavity, the paranasal sinuses, the nasopharynx, the larynx, the trachea and bronchi.

- **Structure:**

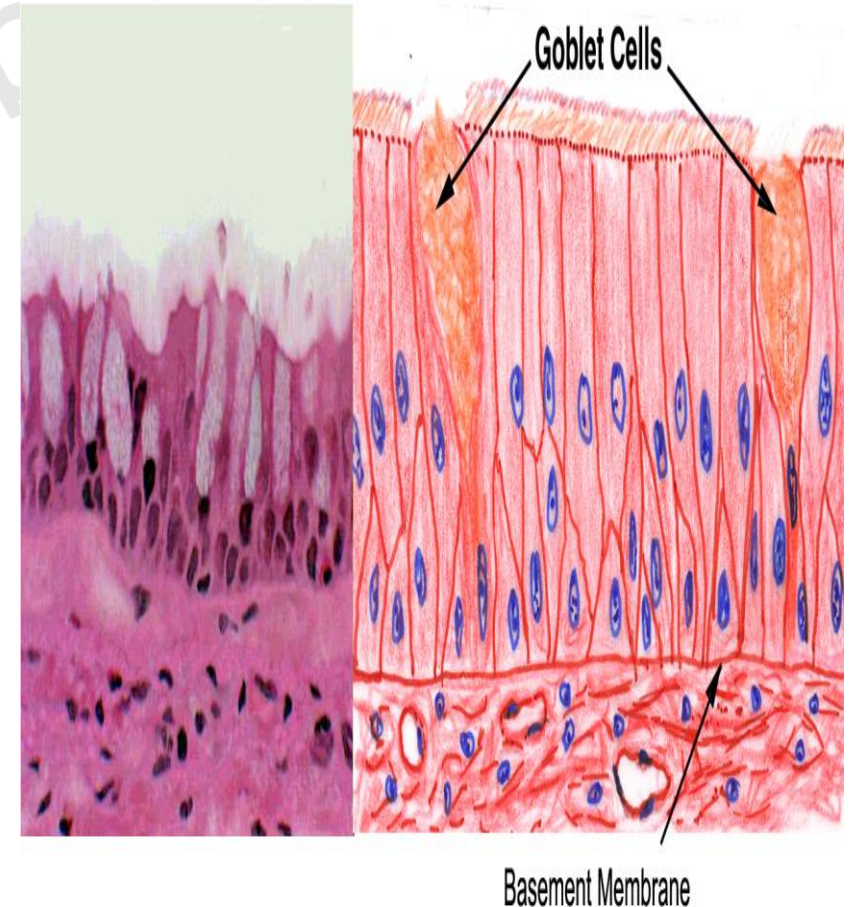
1- **Epithelium:** *Pseudostratified ciliated columnar with goblet cells.*

2- **Lamina propria:**

- Highly vascular (**WHY**).
- Firmly attached to the perichondrium and periosteum of the underlying cartilage or bone (**WHY**).
- Contains:

A- **Immune cells:** plasma cells, mast cells and lymphoid nodules as part of the mucosa- associated lymphoid tissue that provide immunological function.

B- **Mucoserous glands:** together with the mucous secreted by goblet cells moves as a continuous mucous blanket that is propelled by the cilia towards the pharynx where trapped particles are swallowed.



A- Conducting portion

1-Respiratory mucosa

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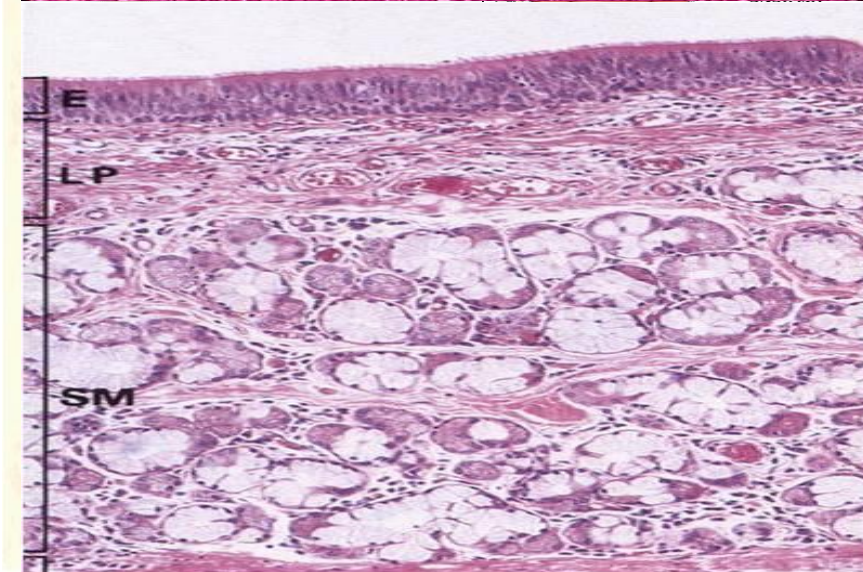
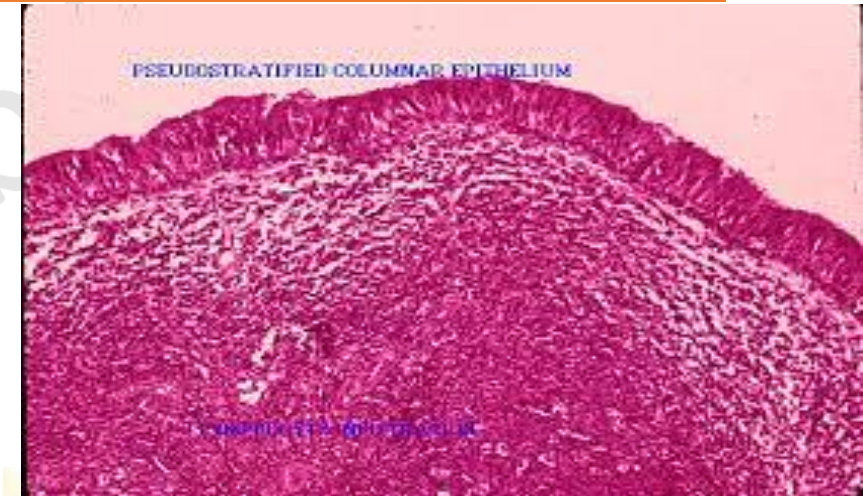
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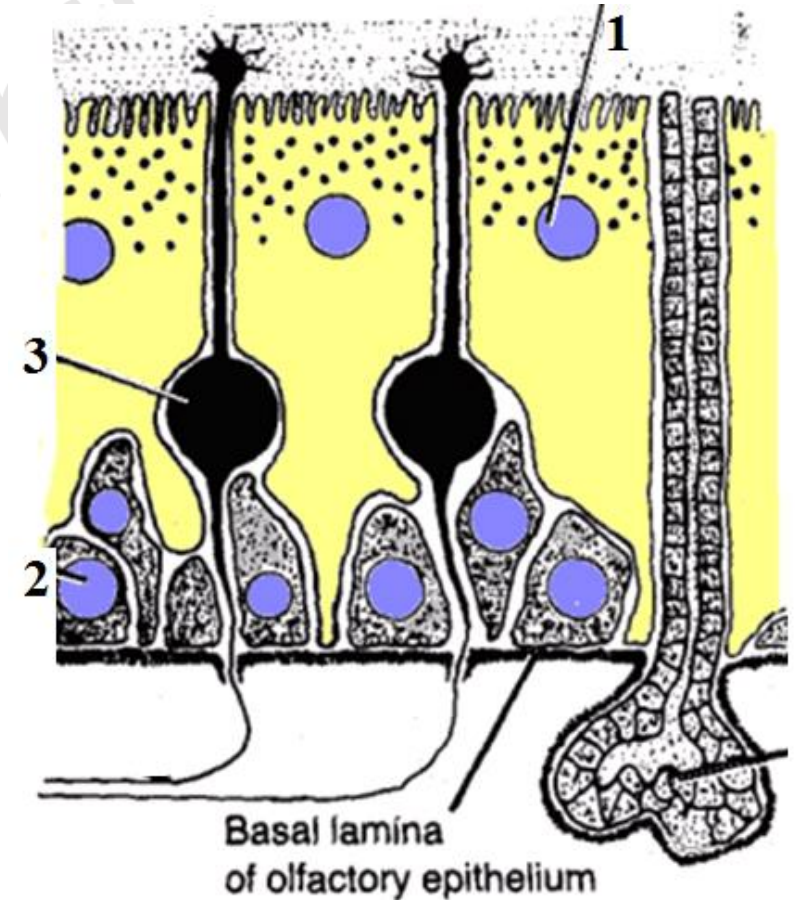


A- Conducting portion

2- Olfactory mucosa

- **Definition:** specialized region of the nasal mucosa for the smell sensation.
- **Site:** at the roof of the nasal cavity.
- **Structure:**

A-Epithelium: *Non ciliated pseudostratified columnar epithelium without goblet cells*, formed of 3 types of cells:



A- Conducting portion

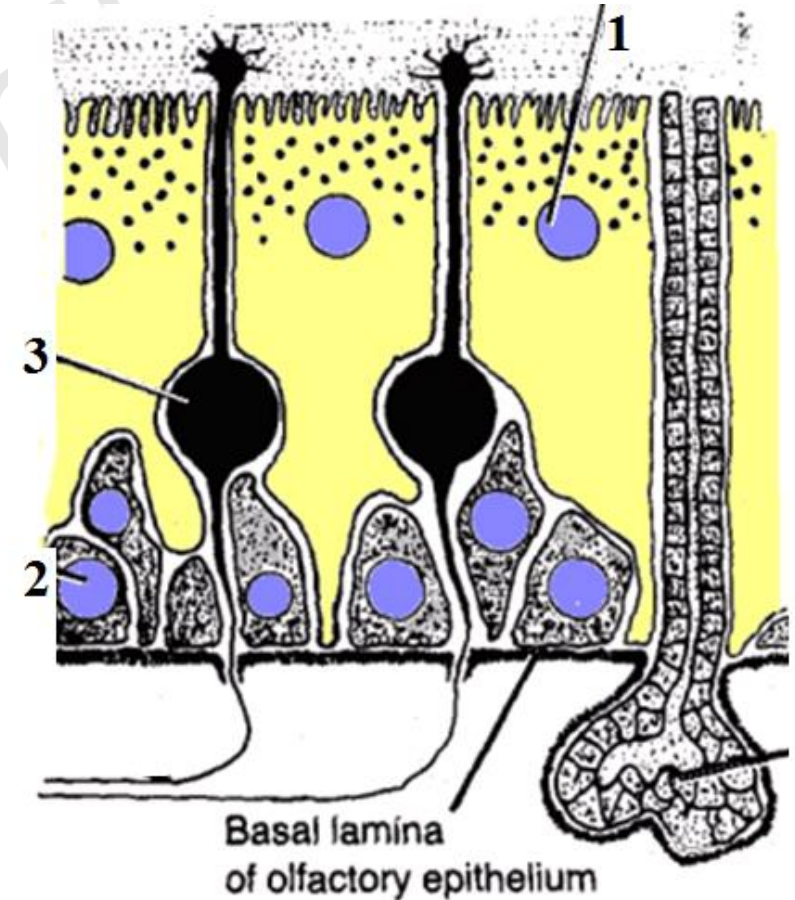
2- Olfactory mucosa

1- **Olfactory cells:** modified bipolar neurons:

- Their dendrites form the olfactory vesicles with olfactory cilia.
- Their axons form olfactory nerve fibers.

2- **Supporting columnar cells.**

3- **Basal cells:** Stem cells that give rise to olfactory cells & supporting cells (site of regenerating neurons in adults)

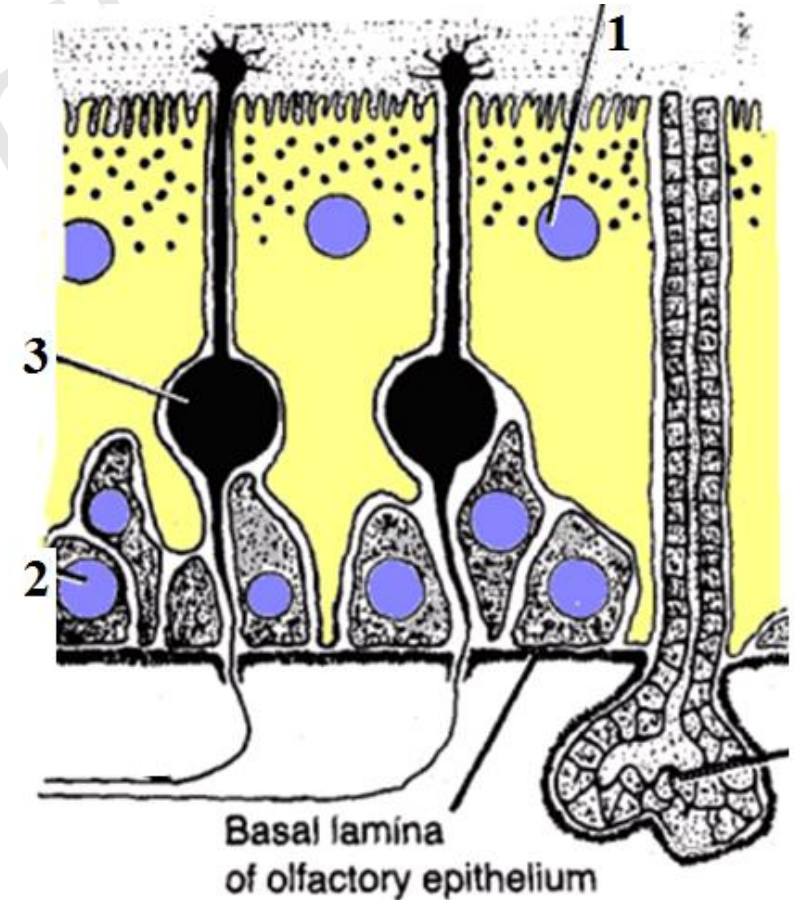


A- Conducting portion

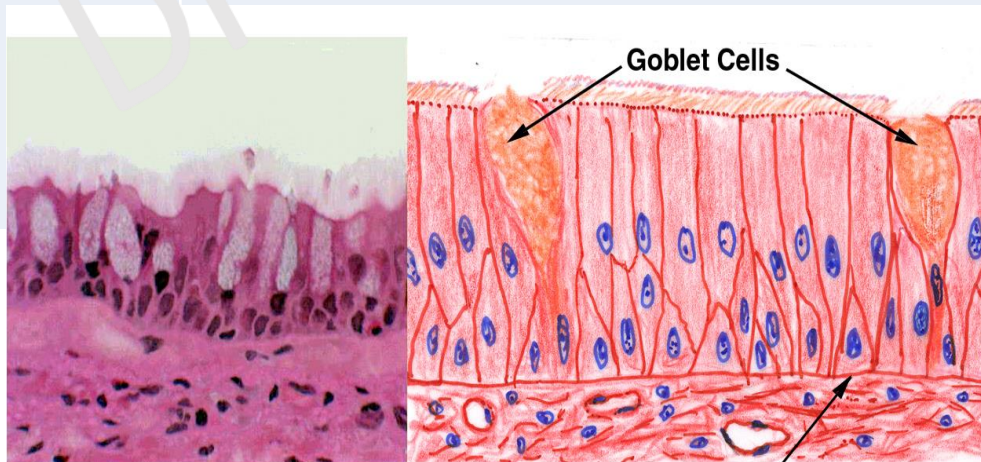
2- Olfactory mucosa

B- Lamina propria: contains *Bowman's glands*:

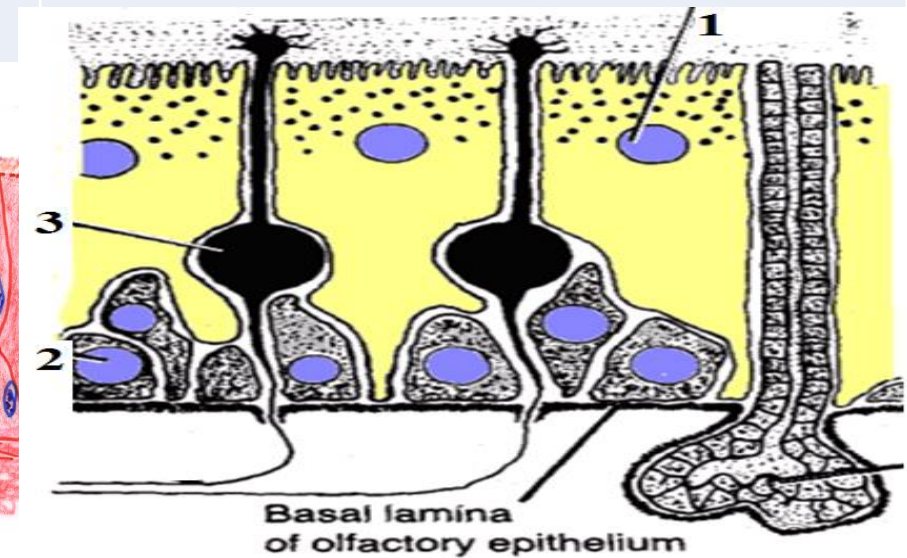
- Serous glands
- **Function:** dissolves the air borne odorants, thus enhance the ability of the olfactory cells to detect scents.



Types	Respiratory mucosa	Olfactory mucosa
Site	Line the nose till the bronchi.	Roof of the nose.
Lining epithelium	Pseudostratified ciliated columnar with goblet cells.	Non ciliated pseudostratified without goblet cells
Lamina propria	.Vascular CT .Mucoserous glands. .Plasma cell, mast cell, lymphoid nodules.	. Bowman s gland. . Nerve fibers of olfactory nerves.
Function	Lining mucosa with protective function.	Perception of smell.



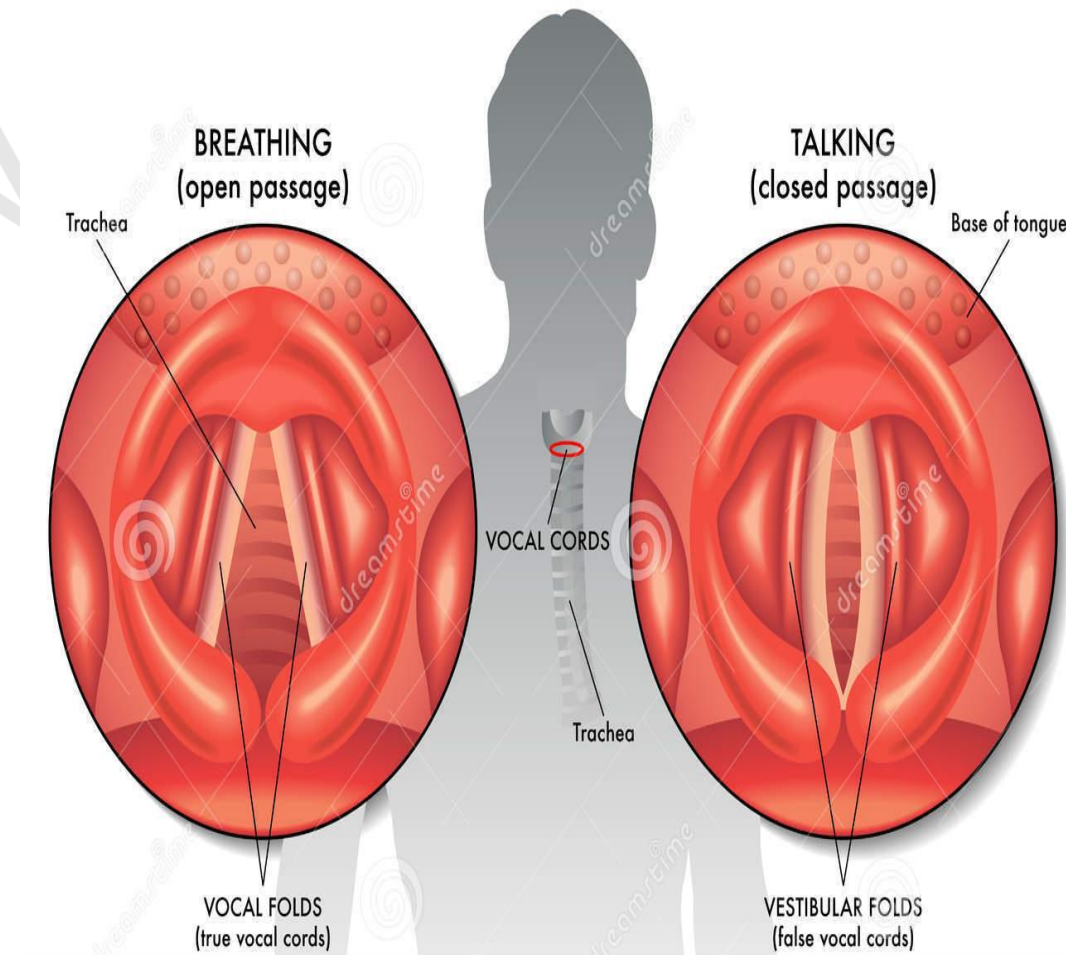
Basement Membrane



I-Larynx

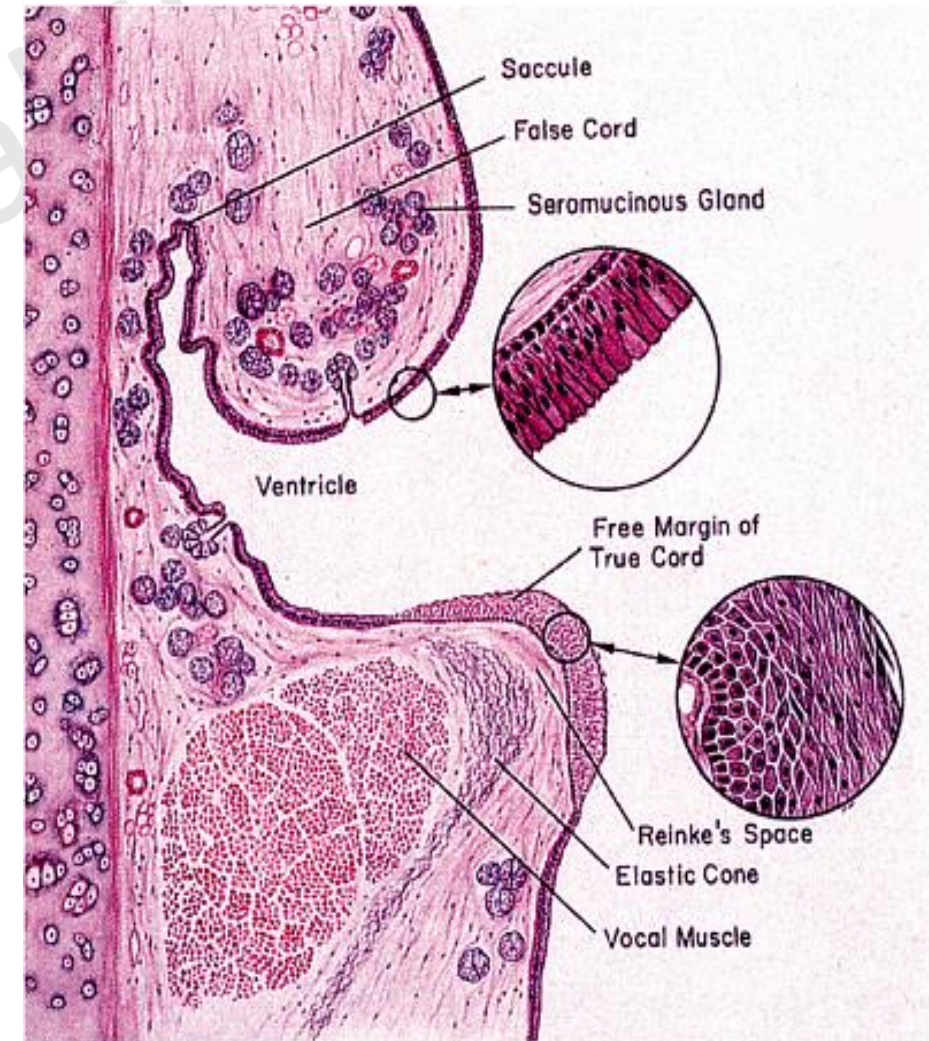
- **Anatomically:**

- a short passage for air between the pharynx and the trachea.
- It is kept open by *the cartilages* present in its wall.
- *The epiglottis* projects upwards and forwards to close the larynx during swallowing.
- Below the epiglottis, two pairs of mucosal folds project inwards from the wall: the upper pair are the *vestibular folds* (false vocal cords) while the lower pair are *the vocal cords*.



I-Larynx

- **Structure:** Most of the larynx is lined by *respiratory mucosa* *Except* the anterior (lingual) surface of the epiglottis and the vocal cords which are covered with *non keratinized stratified squamous epithelium*.
- The core of the vocal cords is made up of *elastic fibers* and *striated muscle* fibers (vocalis muscle) with no glands.

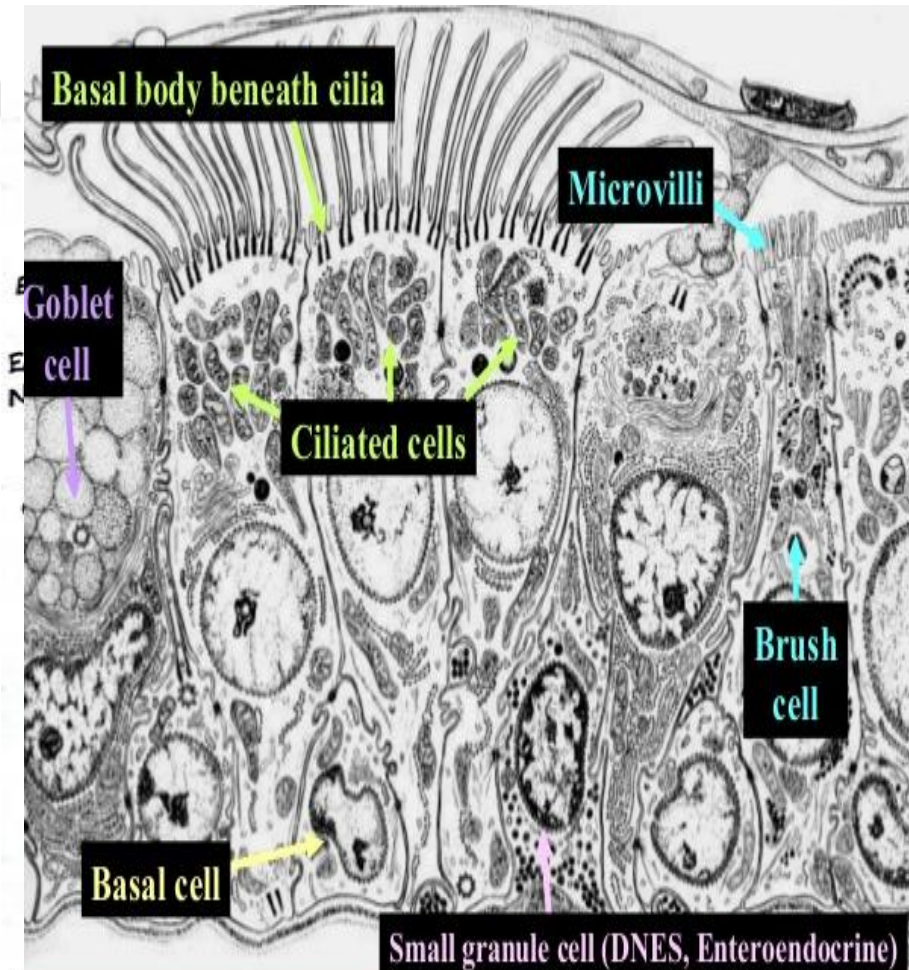


II-Trachea

1- Mucosa

A- Epithelium: The trachea is lined by respiratory epithelium, composed of:

- 1- **Ciliated columnar cells:** the most numerous type.
- 2- **Goblet cells:** have an expanded apical region filled with mucinogen granules.
- 3- **Basal cells:** small pyramidal cells located between the bases of the other cells.
 - **Function:** stem cells for formation of new ciliated and goblet cells.
- 4- **Brush cells:** columnar cells with microvilli at their luminal border.
 - **Function:** act as sensory receptors as they establish synaptic contact with an afferent nerve ending.
- 5- **Small granule cells:** they belong to the diffuse neuroendocrine system. Their cytoplasm contains secretory granules.
 - **Function:** have a neuro- endocrine function.

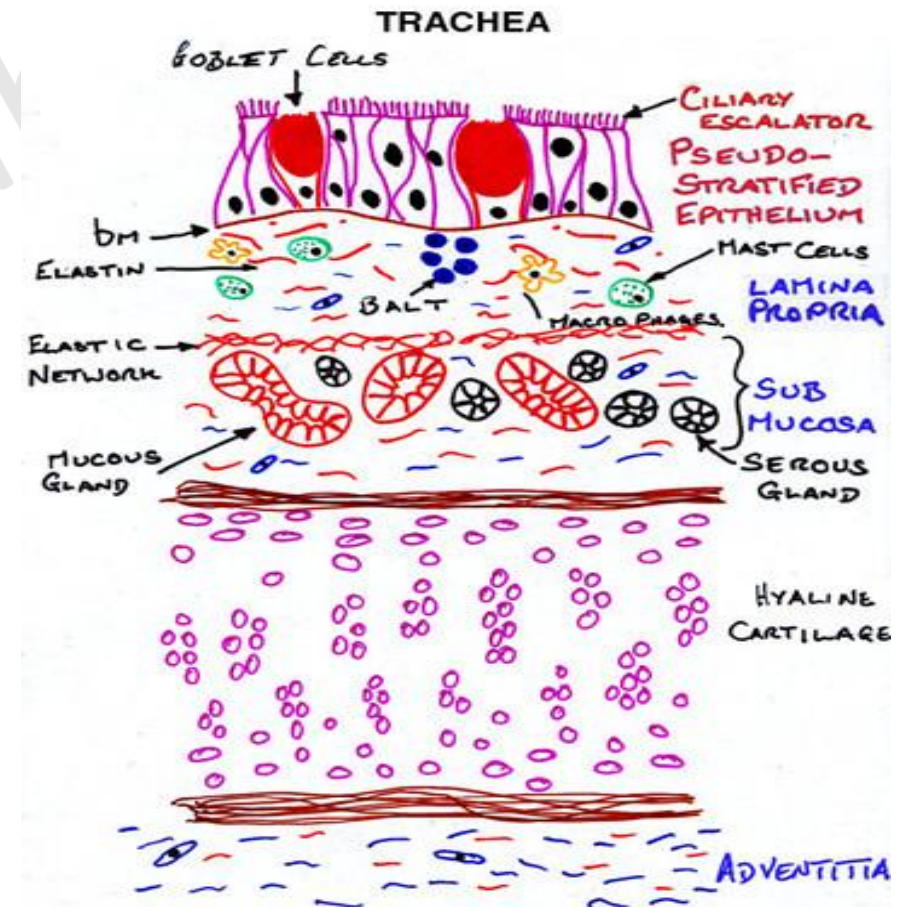


Trachea

1- Mucosa

B-The lamina propria:

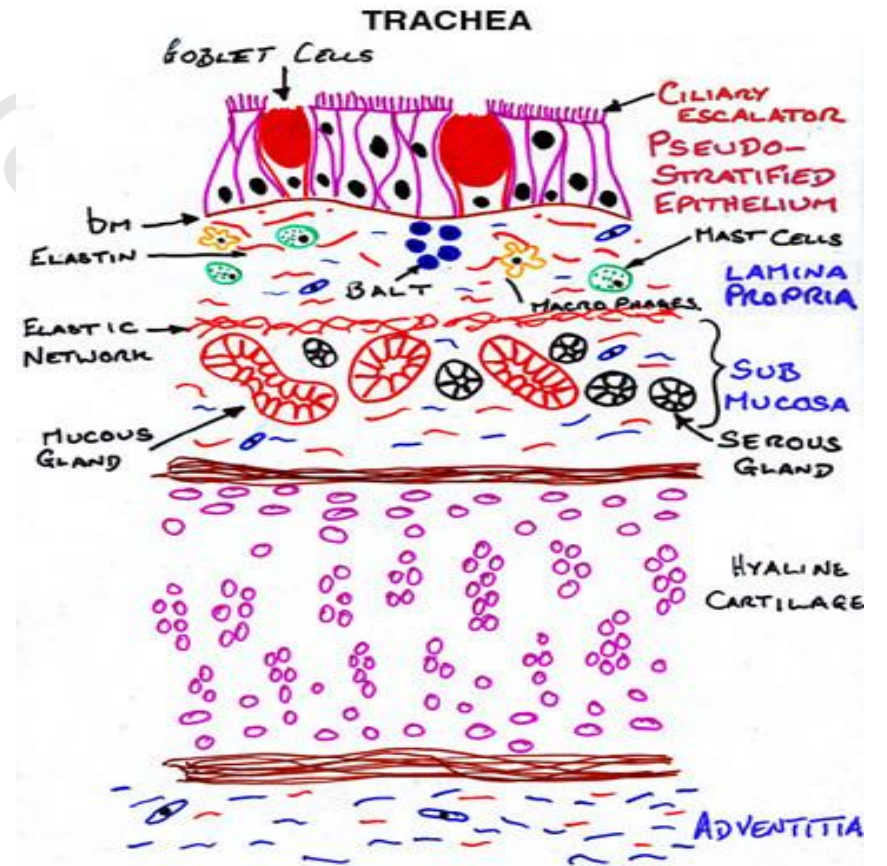
- Loose connective tissue contains *lymphoid nodules*.
- The elastic fibers are condensed to form an *elastic membrane* separating the lamina propria from the submucosa.



Trachea

2- Submucosa

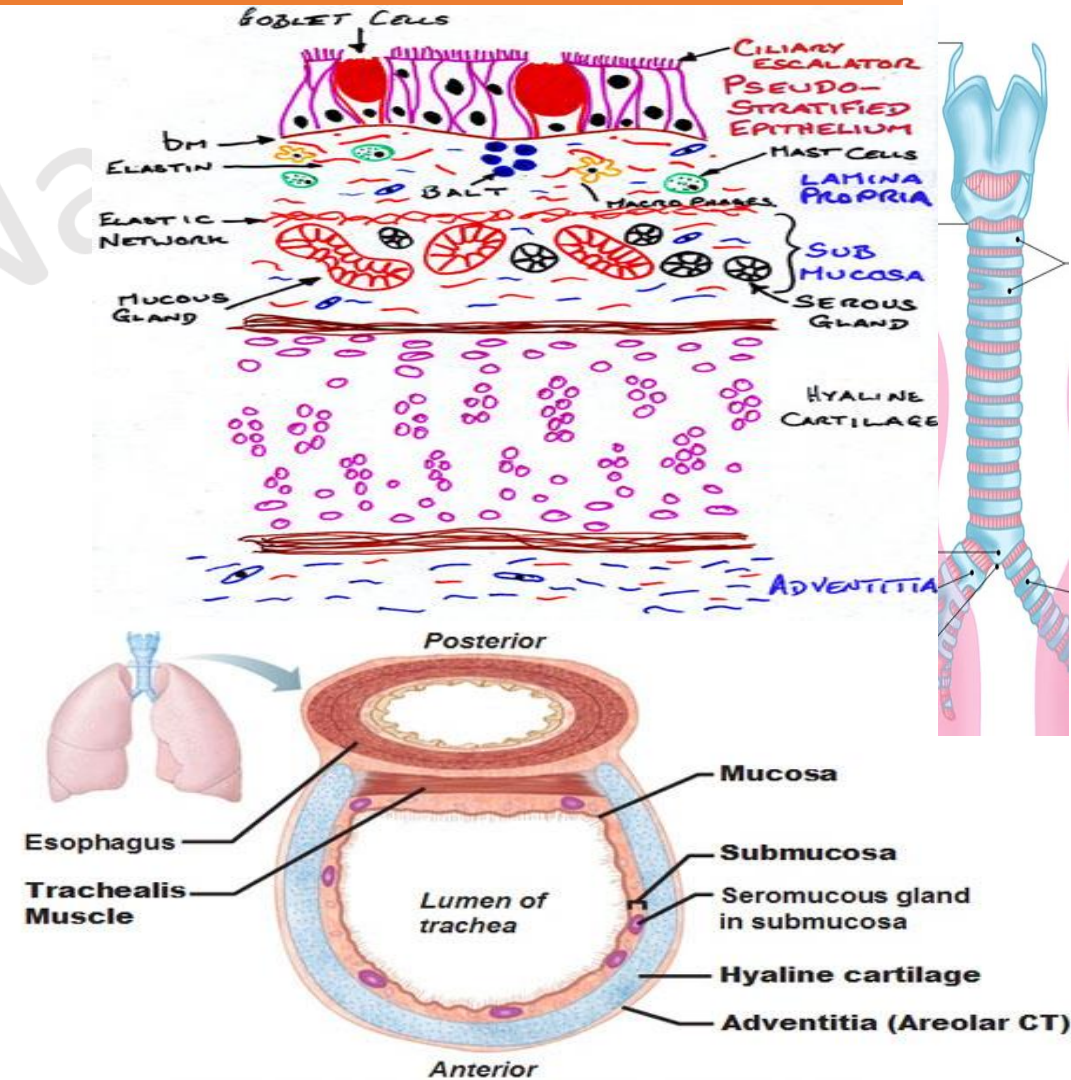
- It contains *submucosal glands* (mucoserous glands).
- Their ducts extend through the elastic lamina to open onto the surface of the mucosa.



Trachea

3- Cartilage layer

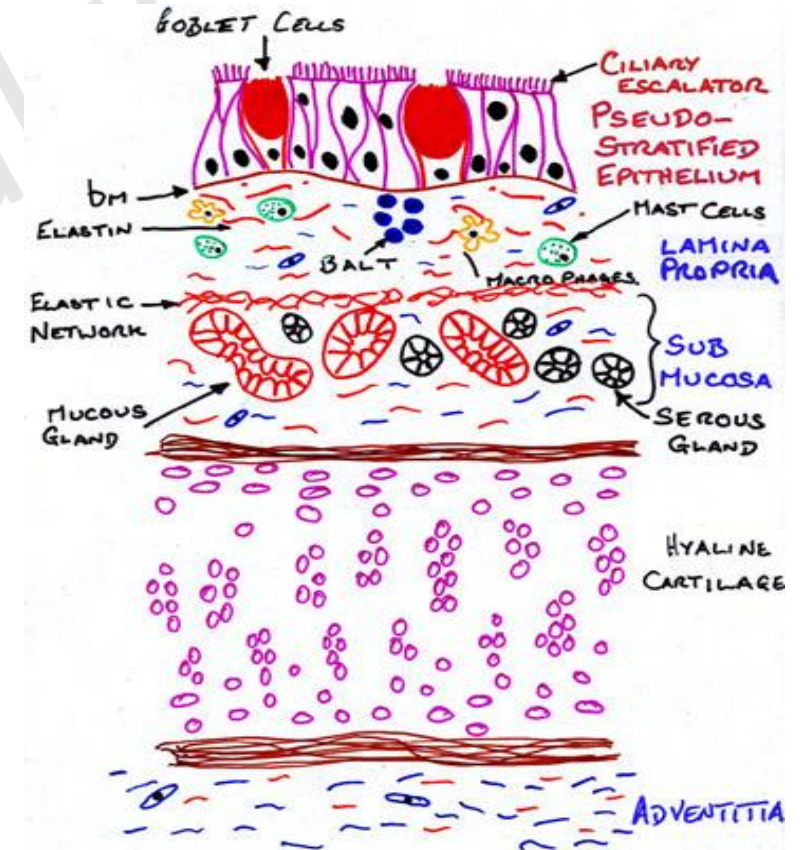
- The tracheal wall is supported by **16-20 incomplete C-shaped rings** of hyaline cartilage, on their ventral and lateral aspects.
- The rings are separated by **fibro-elastic connective tissue** to prevent over distension of the tracheal lumen.
- The posterior wall of the trachea contains **trachealis muscle** (transversely arranged smooth muscle fibers) which connects the two ends of the C-shaped cartilage rings.



Trachea

4- Adventitia

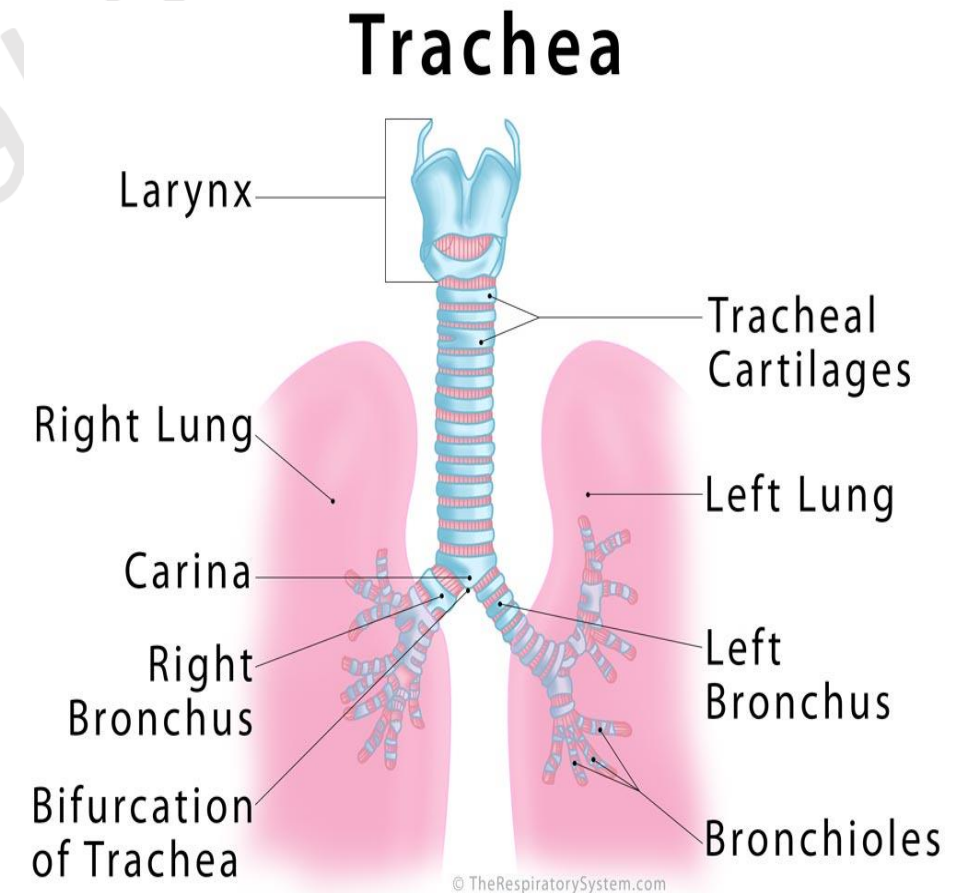
- It is formed of *fibro-elastic connective tissue* that binds the trachea to the adjacent structures.
- It contains the large blood vessels and nerves that supply the trachea.



III-Bronchi

1- Extrapulmonary bronchi

- Its structure is similar to the trachea *except* the cartilaginous rings *completely* encircle the lumen.



Bronchi

2- Intrapulmonary bronchi

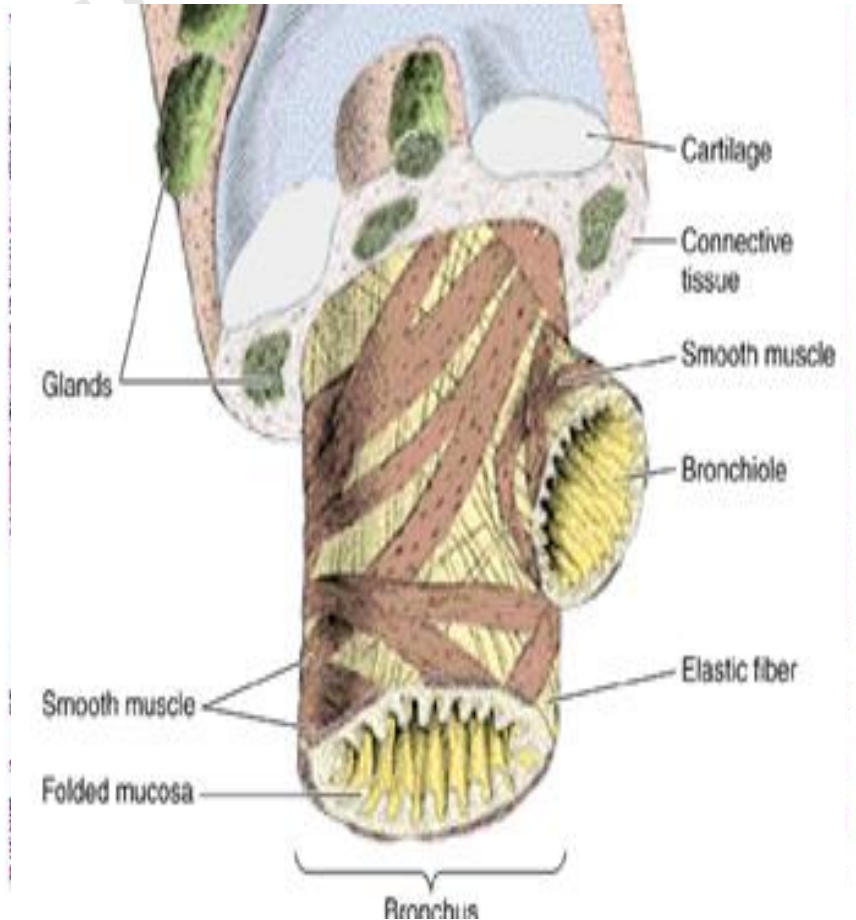
1- Mucosa:

A- Epithelium: respiratory epithelium, the height of the epithelial cells decreases as the bronchi decreases in diameter.

B- Lamina propria: similar to that of the trachea but is reduced in amount in proportion to the diameter.

2- Musculosa: Smooth muscle fibers are spirally arranged encircling the entire lumen.

3- Submucosa: contains muco-serous glands.

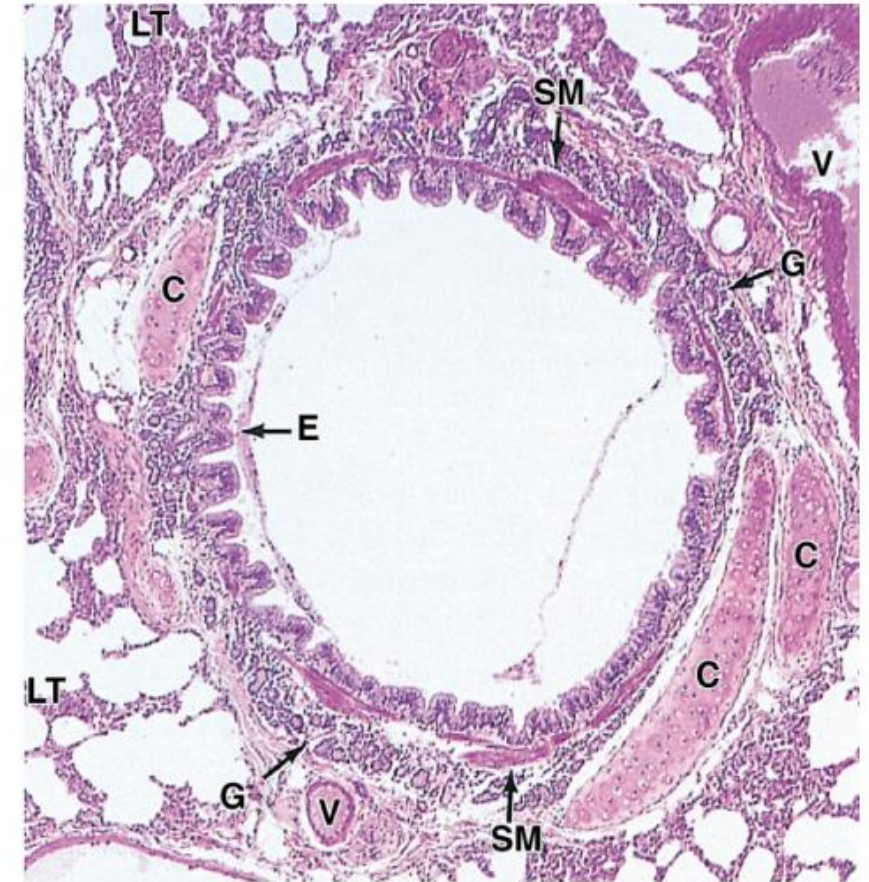


Bronchi

2- Intrapulmonary bronchi

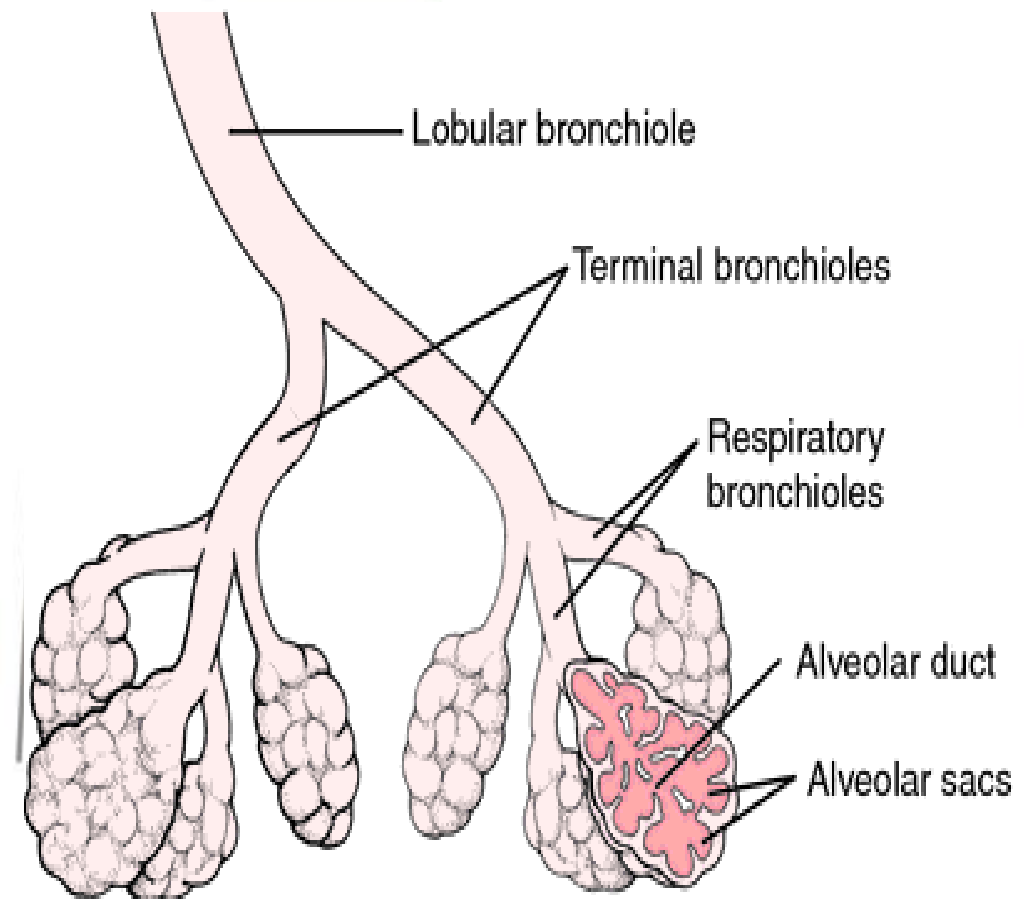
4- Cartilage layer: *discontinuous plates* of hyaline cartilage where they are separated by the glands of the submucosa.

5- Adventitia: Formed of *fibro-elastic* connective tissue.



IV- Bronchioles

- **Definition:** Branches of the bronchi that enter the lung lobules, they measure 1mm or less in diameter.
- Larger bronchioles branch, giving rise to the smaller *terminal bronchioles* (less the 0.5mm in diameter), these are the last parts of the conducting portion.



Bronchi →

Smooth m,elastic fibers ↑

Cartilage ↓



Bronchioles

IV- Bronchioles

1- Mucosa

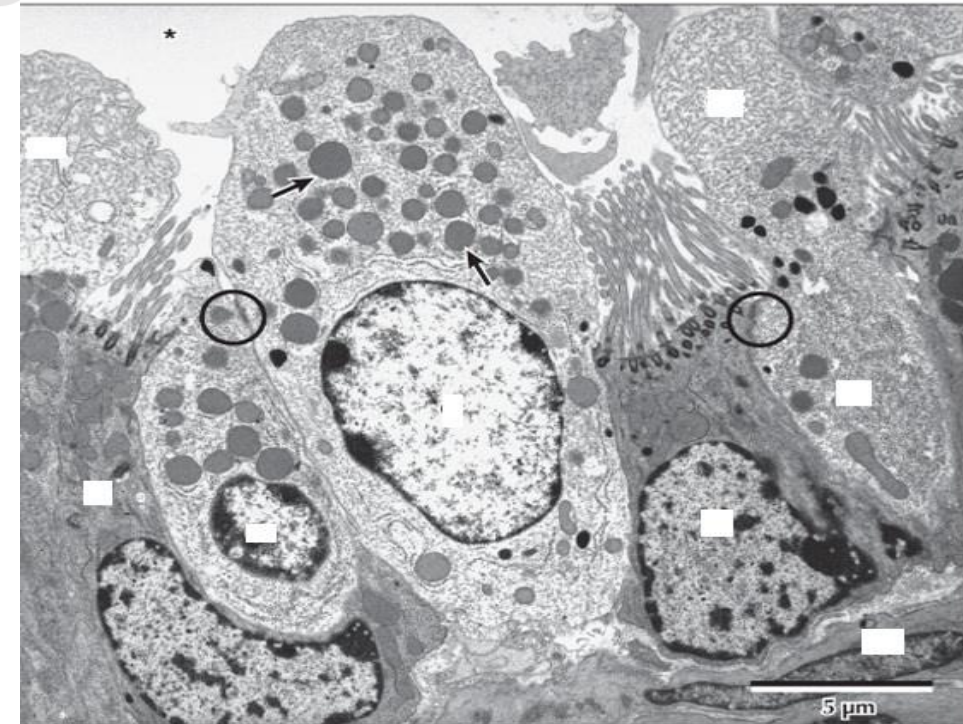
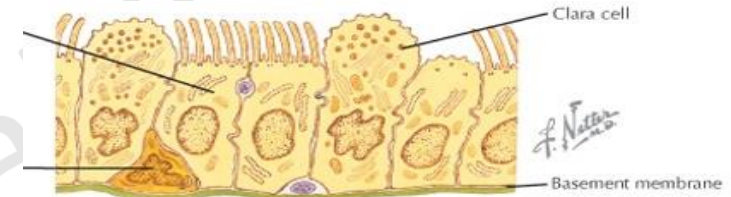
- It is thrown into prominent folds due to contraction of the smooth muscle fibers during fixation of the histological specimen.

A-Epithelium: larger bronchioles are lined by pseudostratified ciliated low columnar epithelium that gradually transform into *simple columnar epithelium with no goblet cells*. It is formed of the following types of cells:

1- **Ciliated cells:** as the cilia move a layer of fluid.

2- **Non-ciliated Clara cells:**

- **Function:** secrete a fluid layer of lipoprotein that is continuous with the surfactant layer of the alveoli to keep the bronchioles patent during expiration.
- **Structure:** dome shaped with microvilli and secretory granules.
- **Number:** They increase as the ciliated cells decrease along the length of the bronchioles.



The cilia gradually disappear and the cells become cuboidal as the bronchioles become smaller.

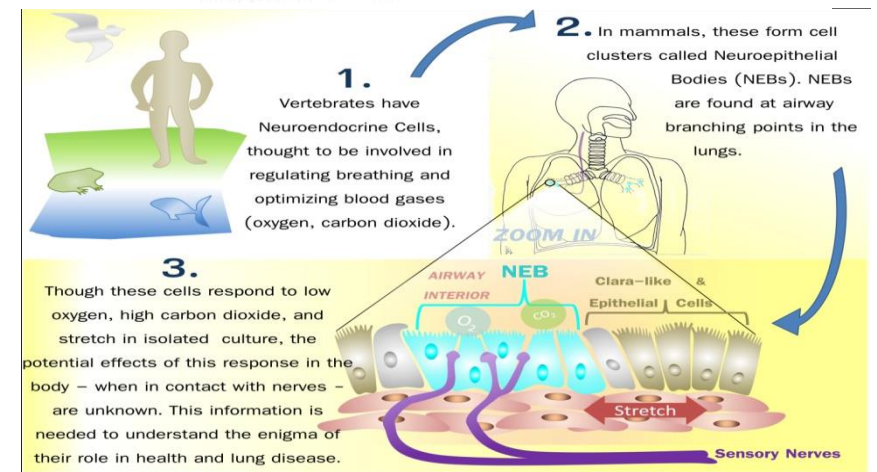
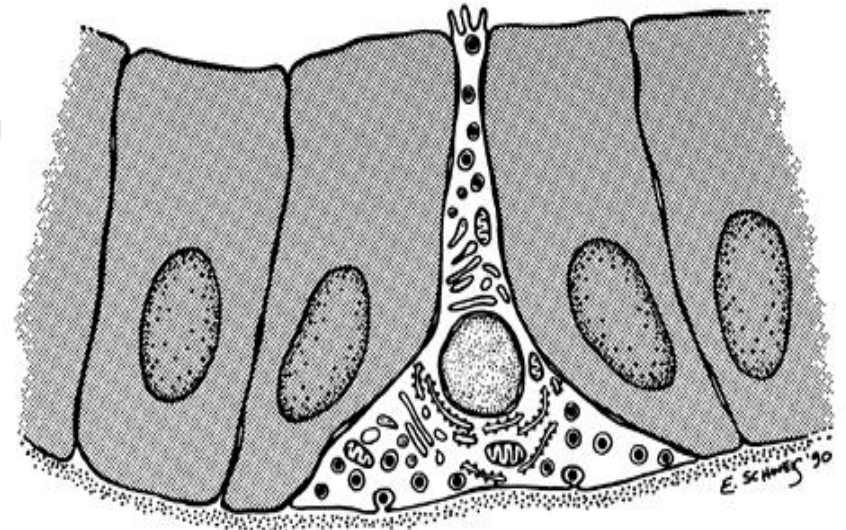
IV- Bronchioles

1- Mucosa

3- **Neuro-endocrine cells**: they are present either singly (small granule cells) or in groups (neuroepithelial bodies).

➤ **Function**: secrete locally active secretion that regulate the airway and vascular caliber.

B- **Lamina propria**: formed of thin layer of loose connective tissue rich in *elastic fibers*.

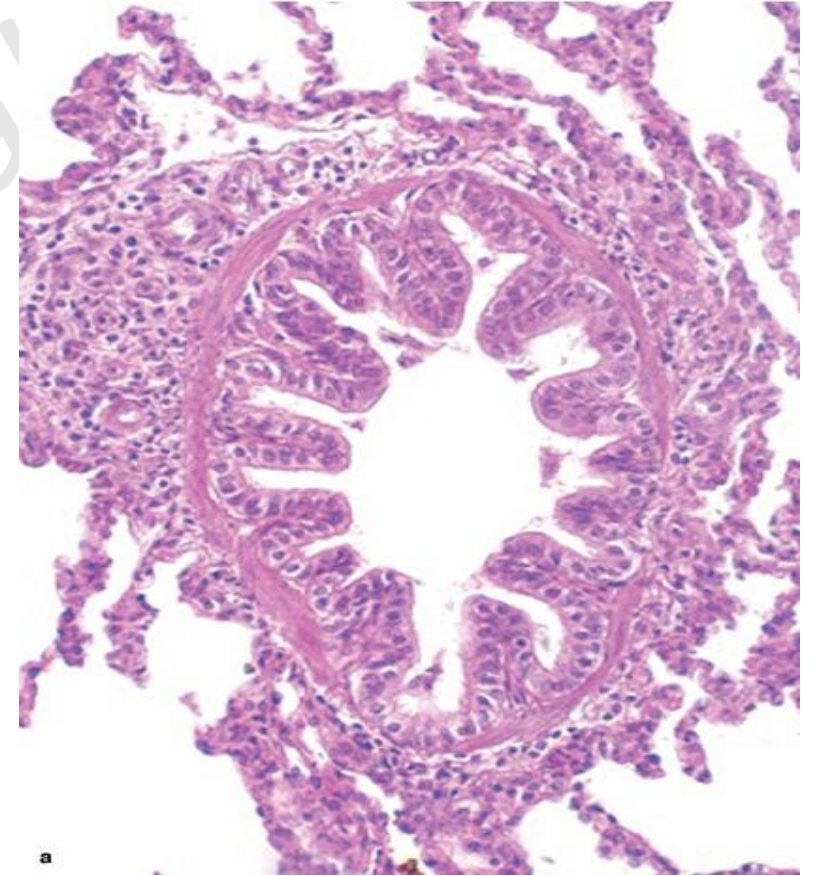
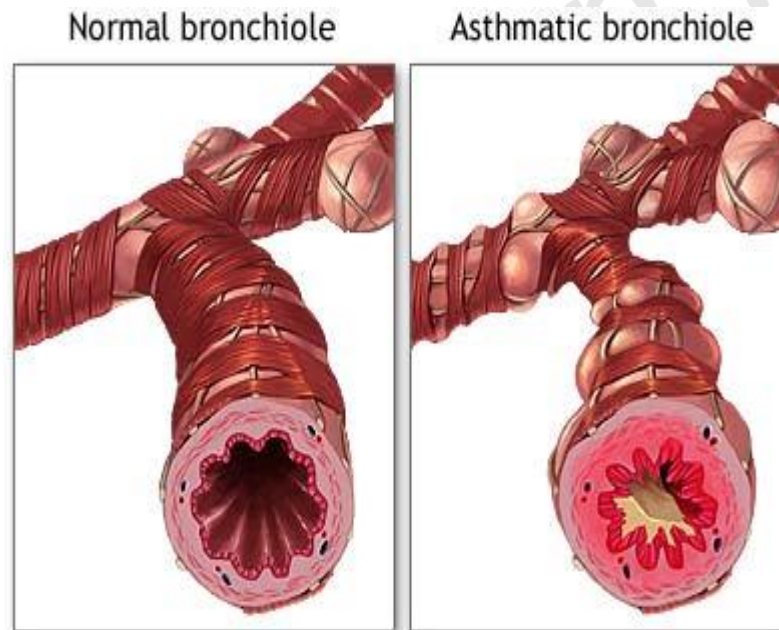


IV- Bronchioles

2,3- Musculosa& Adventitia

2- Musculosa: prominent circular smooth muscle fibers.

3- Adventitia: connective tissue rich in *elastic fibers*.



Bronchioles have 3 No s: No cartilaginous plates, no lymphoid nodules and no glands.

