

The Functional Histology of Respiratory System

The Respiratory System

Function of the respiratory system

**Replenish blood oxygen levels which is.1
.needed for tissue metabolism**

**Remove the carbon dioxide from the blood.2
which produced as a by product of metabolic
.activity**

**To assist the body in maintaining a near.3
constant PH**

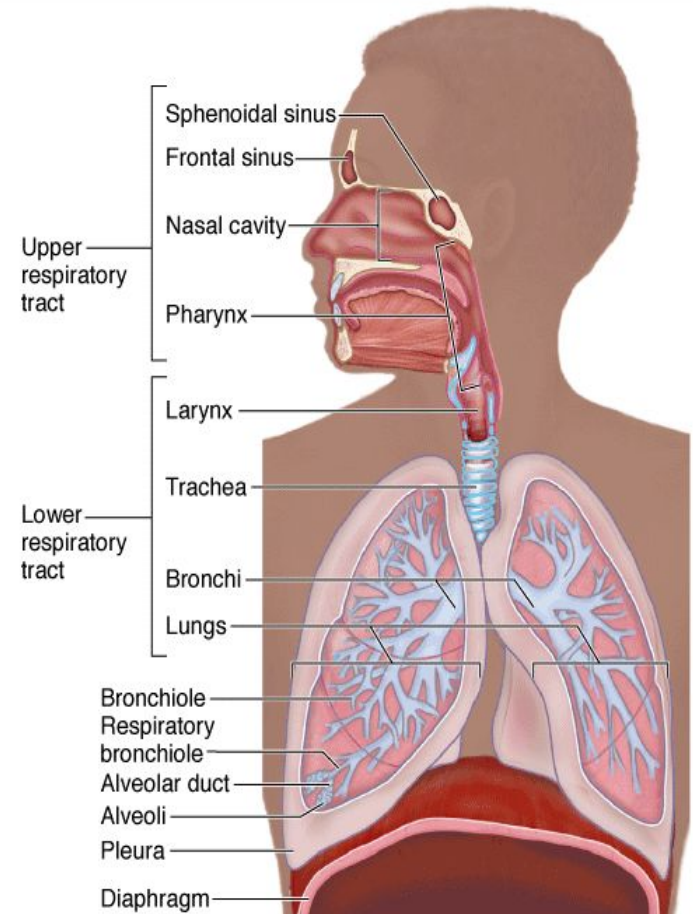
The Respiratory System consist of

Conducting portion,.1

which consists of the nasal cavities, nasopharynx, larynx, trachea, bronchi ,bronchioles, and terminal bronchioles

Respiratory portion.2

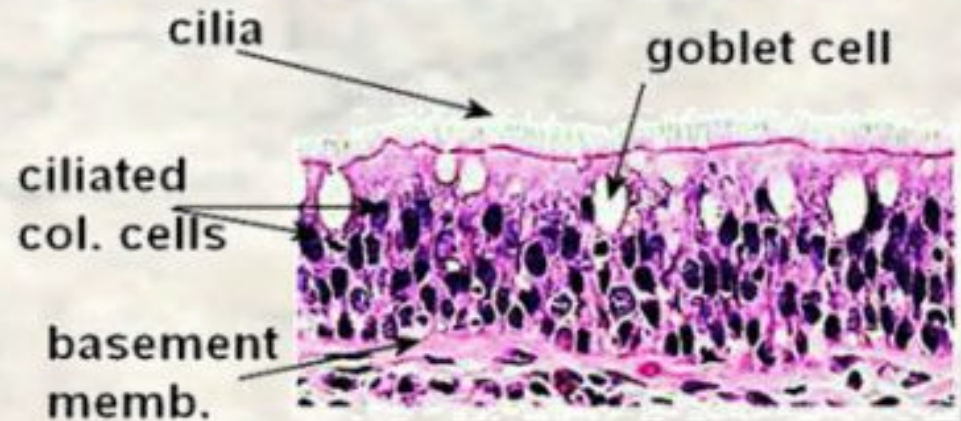
(where gas exchange takes place), consisting of respiratory bronchioles, alveolar ducts, .alveolar sacs and alveoli



Conducting portion

The Respiratory Epithelium

- 1- Ciliated columnar cells (~30%)
- 2- Goblet cells (~30%).
- 3- Brush cells
- 4- Basal (short) cells
- 5- The small granule cell



ciliated pseudostratified columnar epithelium

Cells of respiratory epithelium

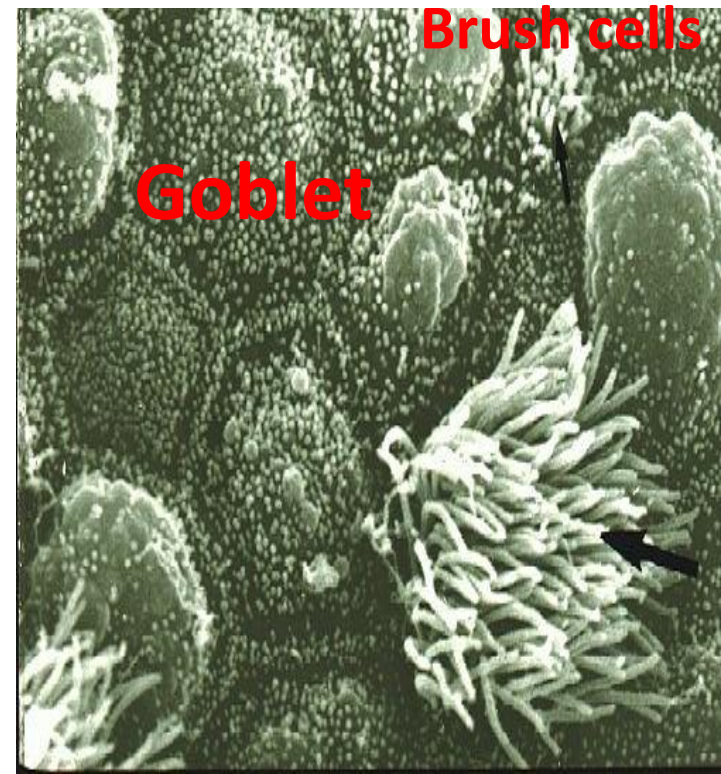
Ciliated columnar cells are the most.1 abundant, each with about 300 cilia . on its apical surface

Goblet cell. filled with granules of.2 mucin

Brush cells. Columnar have afferent.3 nerve endings on their basal surfaces and are considered to be chemosensory receptors

Small granule :3% and are part of the.4 diffuse neuroendocrine system

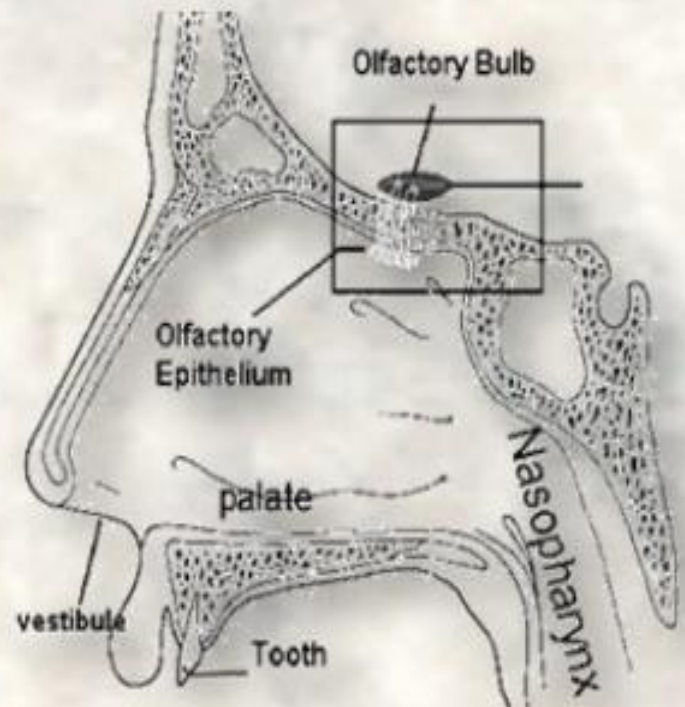
Basal cells, small rounded cells on.5 the basement, are **stem cells** that .give rise to the other cell types



The Nasal Cavity

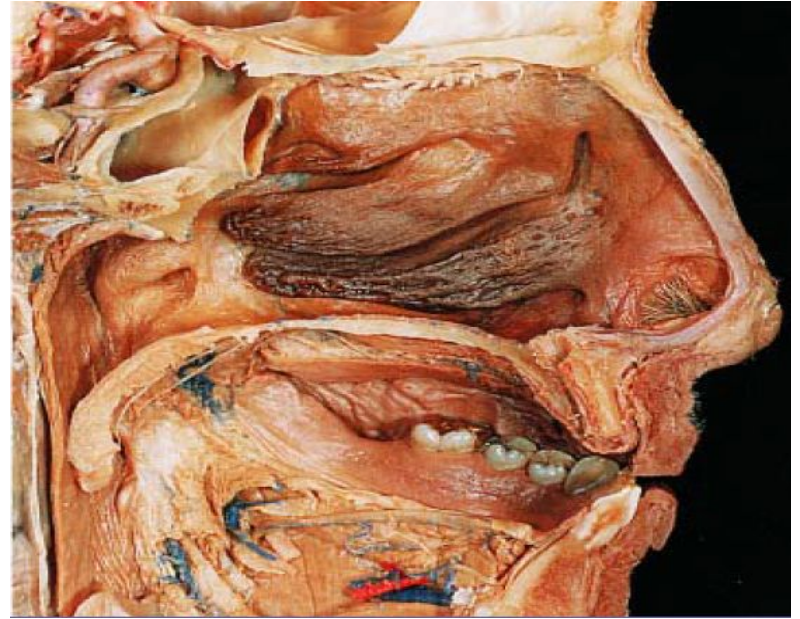
Three main anatomical areas:

- 1) *The Vestibule*: skin + sebaceous glands + hairs.
- 2) *Respiratory Area*: highly vascular erectile C.T. covered by respiratory epithelium (*pseudo stratified columnar ciliated epithelium with goblet cells*).
- 3) *Olfactory mucosa*: covered with olfactory epithelium to conduct the sense of olfaction



The nasal cavities (respiratory area)

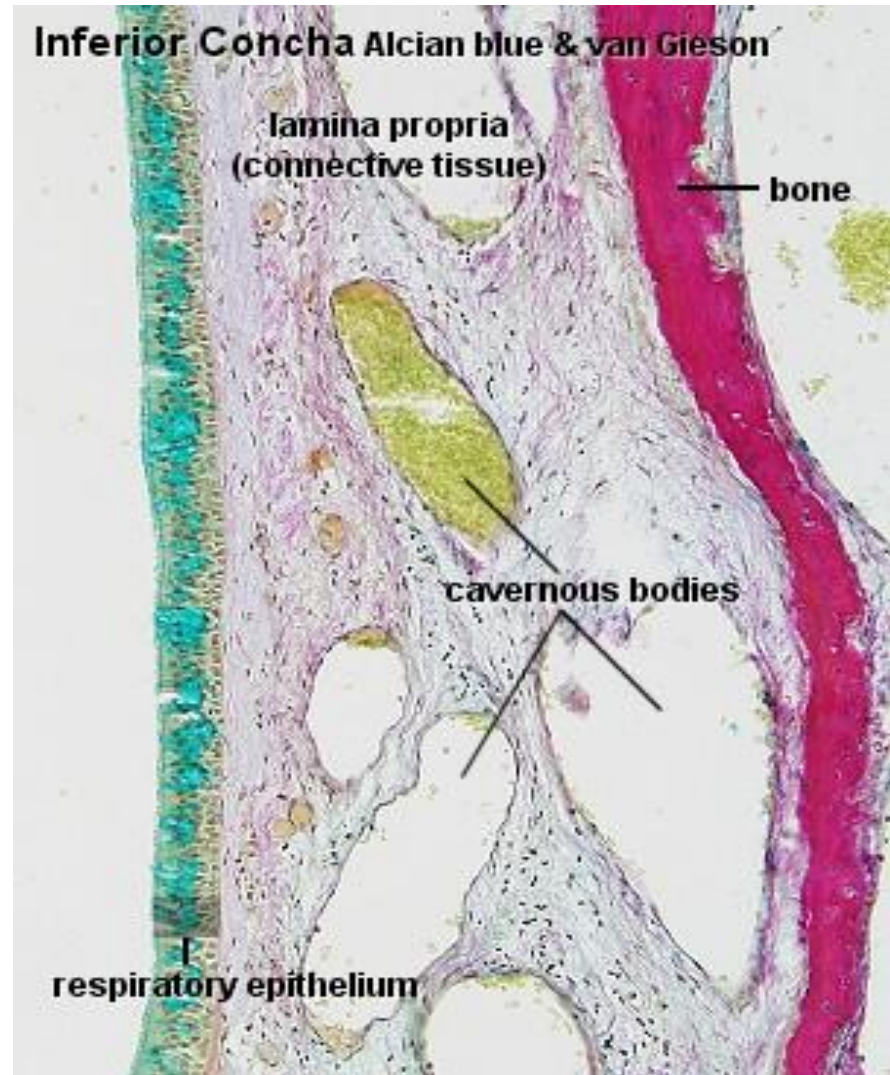
lie within the skull as two cavernous chambers separated by the **osseous nasal septum**. Extending from each lateral wall are three bony shelflike projections called **conchae**. The middle and inferior conchae are covered with **respiratory epithelium**; the superior concha is covered with a specialized **olfactory epithelium**.



The narrow passages between the conchae improve the conditioning of the inspired air by increasing the surface area of moist, warm respiratory epithelium and by slowing and increasing turbulence in the airflow

Swell bodies(cavernous bodies)

Within the lamina propria of the conchae are large venous plexuses known as **Swell bodies**. Every 20–30 minutes, the swell bodies on one side become temporarily engorged with blood, resulting in distension of the conchal mucosa and a concomitant decrease in the flow of air. During this time, most of the air is directed through the other nasal fossa, allowing the engorged respiratory mucosa to recover from dehydration



Smell (Olfaction)

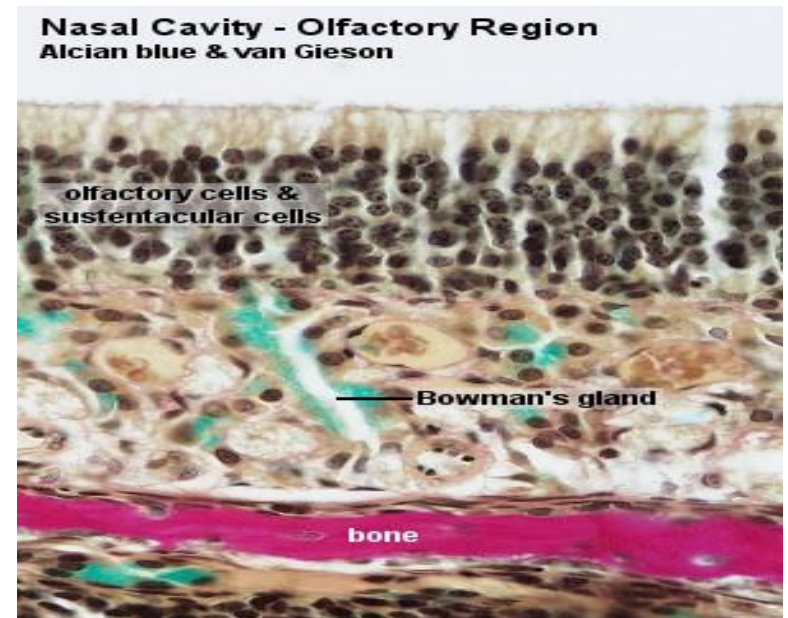
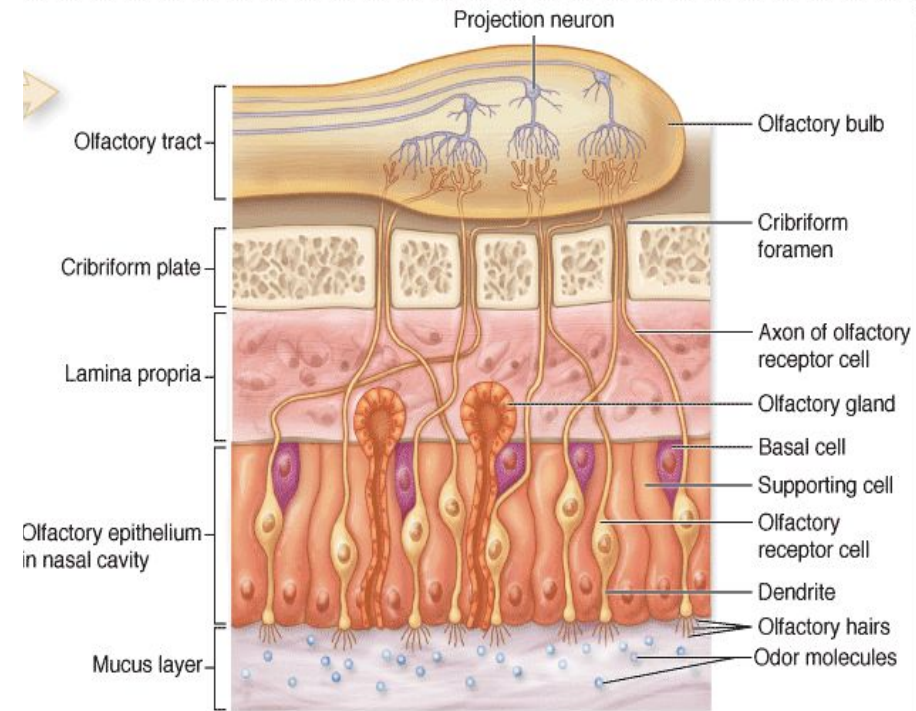
cells of olfactory epithelium

Basal cells are small, spherical..1

They are the stem cells for the
.other two types

Supporting cells are columnar,.2
with broad, cylindrical apices
..and narrower bases

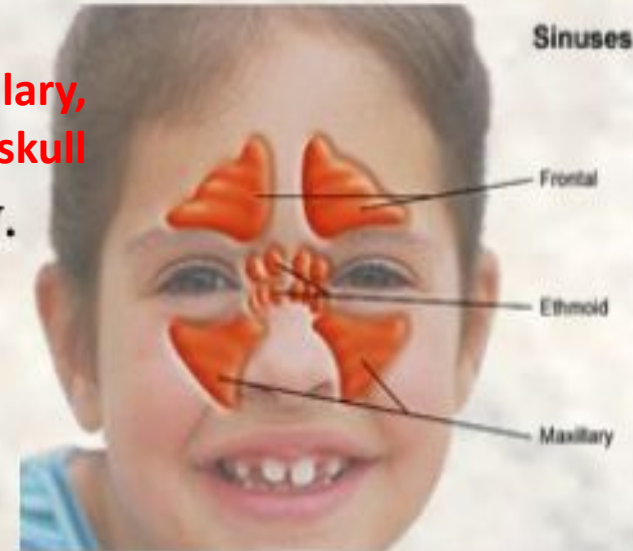
Olfactory neurons are bipolar..3
neurons present throughout this
epithelium. They are
distinguished from supporting
cells by the position of their
nuclei, which lie between those
of the supporting cells and basal
cells. neurons are replaced
.regularly



Upper Respiratory System

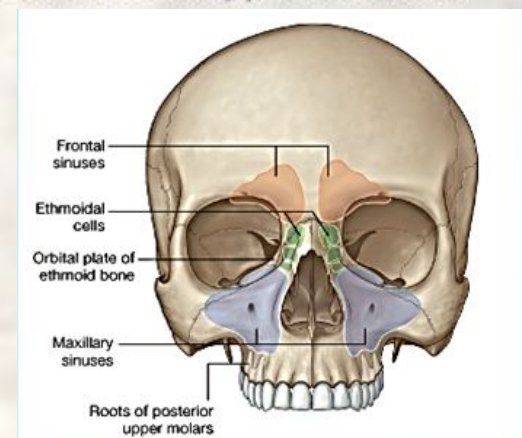
➤ *Nasal Sinuses* **bilateral cavities in the frontal, maxillary, ethmoid, and sphenoid bones of the skull**

- skull cavities which open into the nasal cavity.
- Help in the phonation of voice
- Lighten the skull weight.
- Covered by respiratory epithelium (fewer goblet cells), which is firmly adherent to the periosteum.



➤ *The Nasopharynx*

- Covered with respiratory epithelium.
- Its corium contains lymphocytes, mucus glands and the adenoids.



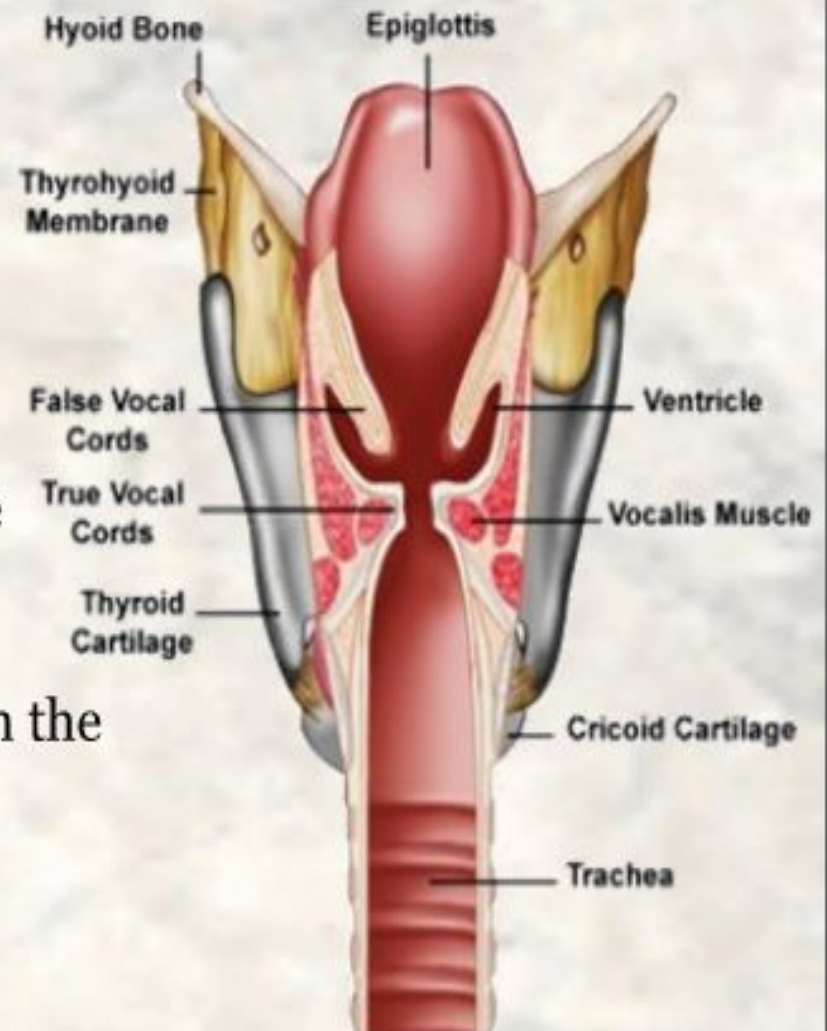
The larynx

- It is an irregular tube that connects the pharynx to the trachea.
- There are several cartilaginous parts inside its lamina propria.
- The *larger* cartilages are *hyaline*.
the thyroid, cricoid, and the inferior arytenoid
- The *smaller* cartilages are *elastic*.
epiglottis, cuneiform, corniculate, and the superior arytenoid cartilages

The larynx

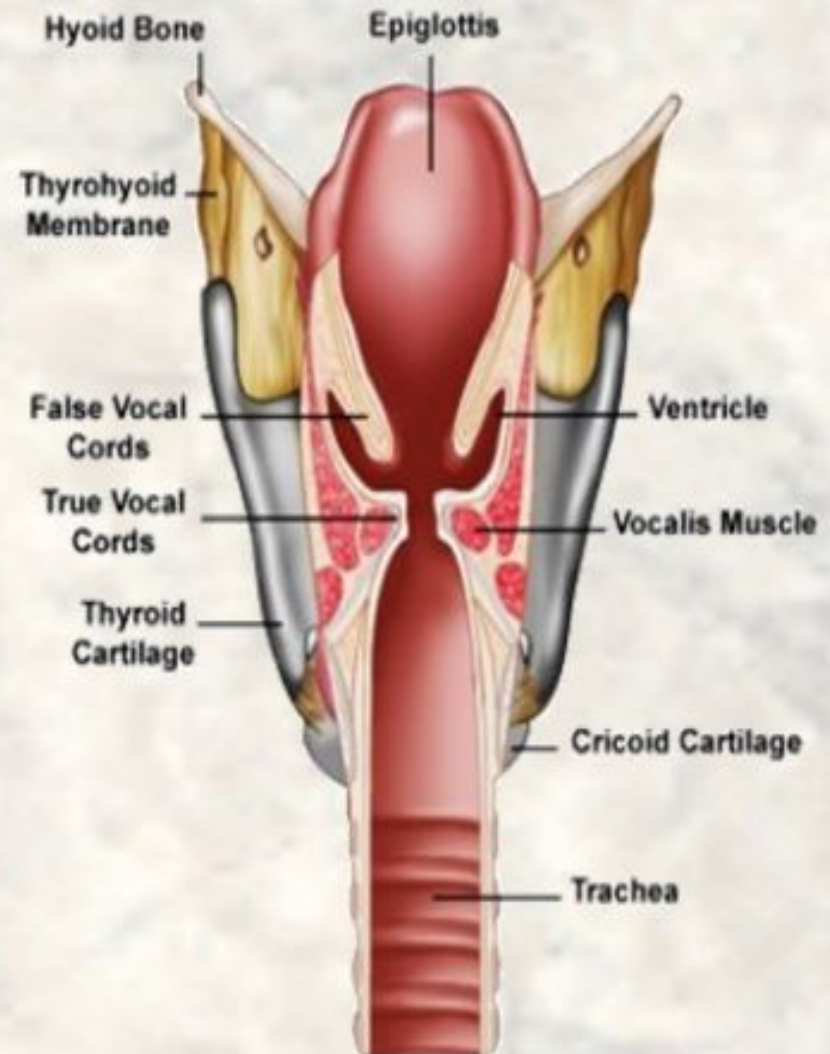
The epiglottis has a lingual and a laryngeal surface.

- The lingual surface is covered with stratified squamous epithelium.
- Toward the base of the epiglottis, the epithelium gradually changes into pseudostratified columnar ciliated on the laryngeal surface.



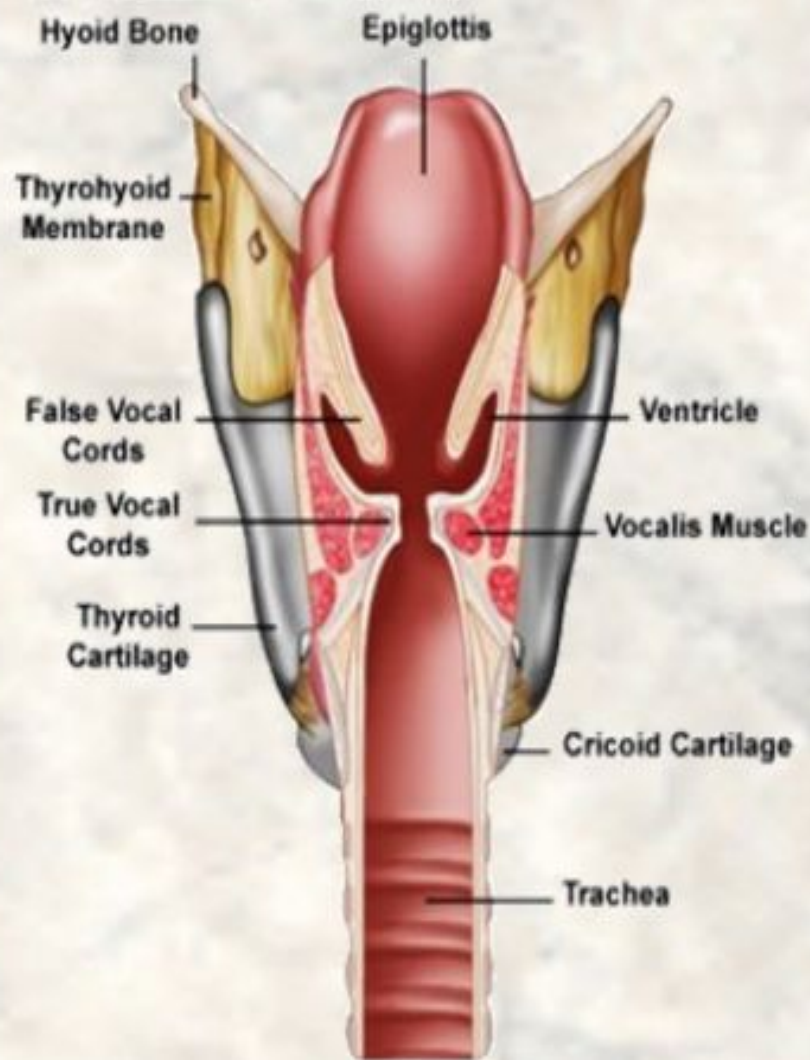
The larynx

- The mucosa below the epiglottis forms 2 pairs of folds that extend into the lumen of the larynx.
- The upper pair constitutes the false vocal cords (vestibular folds), covered with *typical respiratory epithelium*.



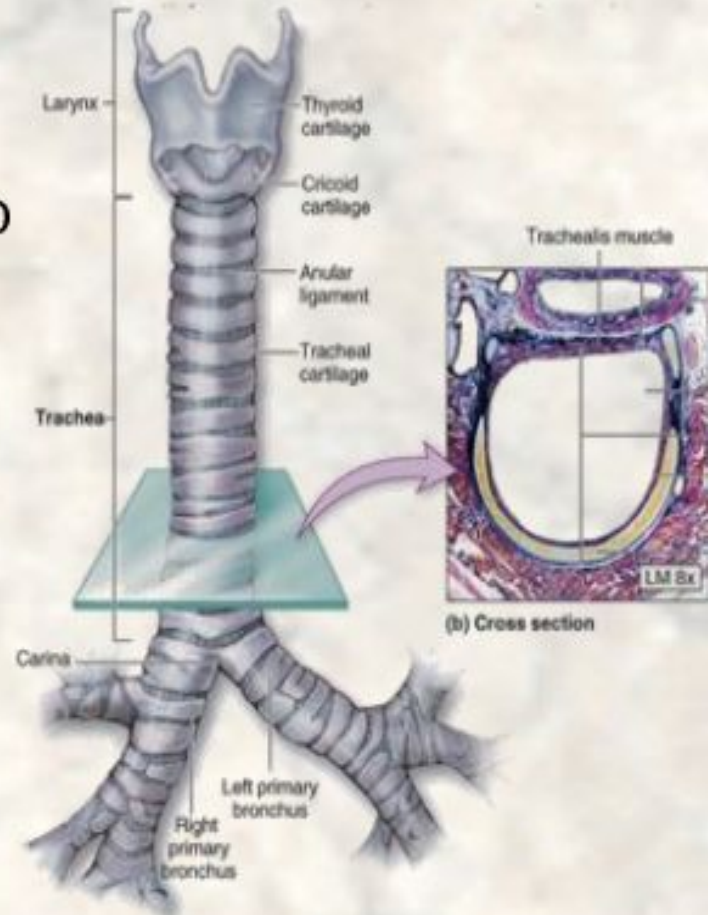
The larynx

- The lower pair of folds constitutes the true vocal cords covered with *stratified squamous epithelium*.
- The vocalis muscles (skeletal m), regulate the tension of the fold.

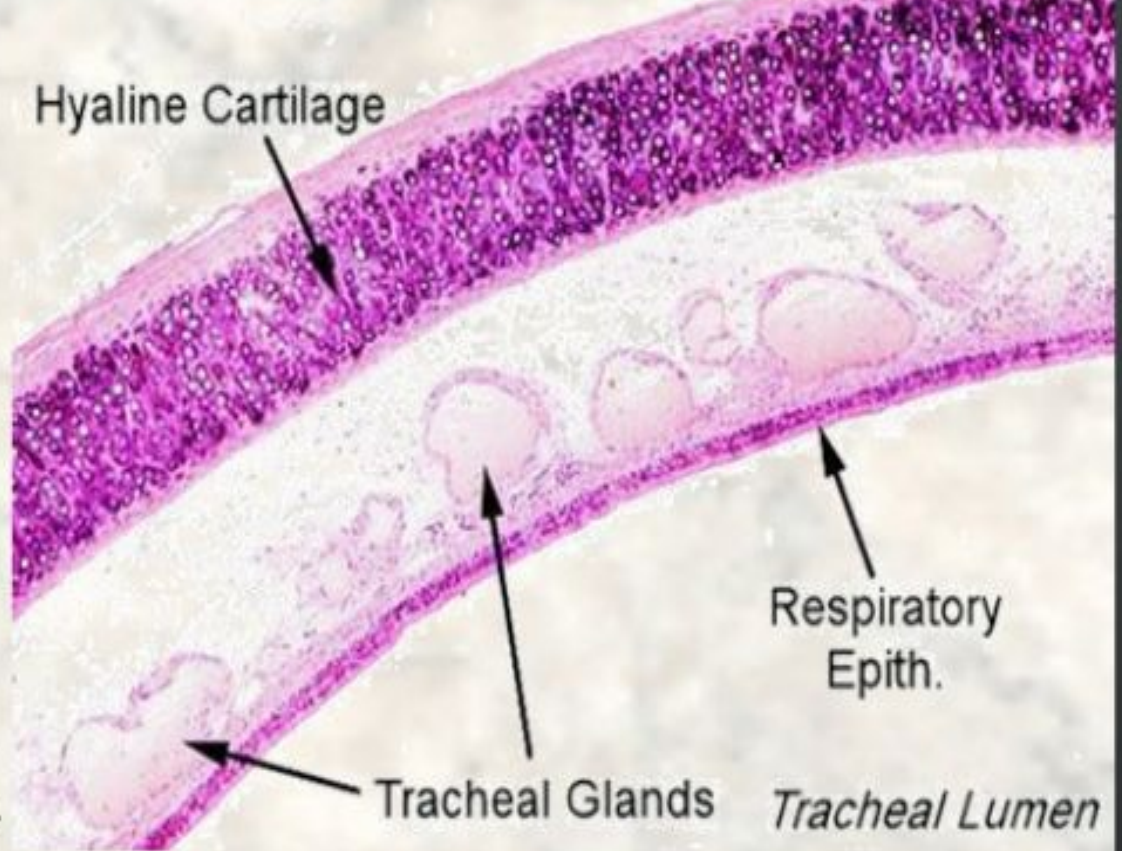


The Trachea

- a cartilaginous tube, extending from the lower part of the larynx and ends by dividing into the two bronchi, one for each lung.
- The wall consists of:
 - 1- *Mucosa*:
 - 2- *Submucosa*
 - 3- *Fibrocartilagenous coat*



The Trachea



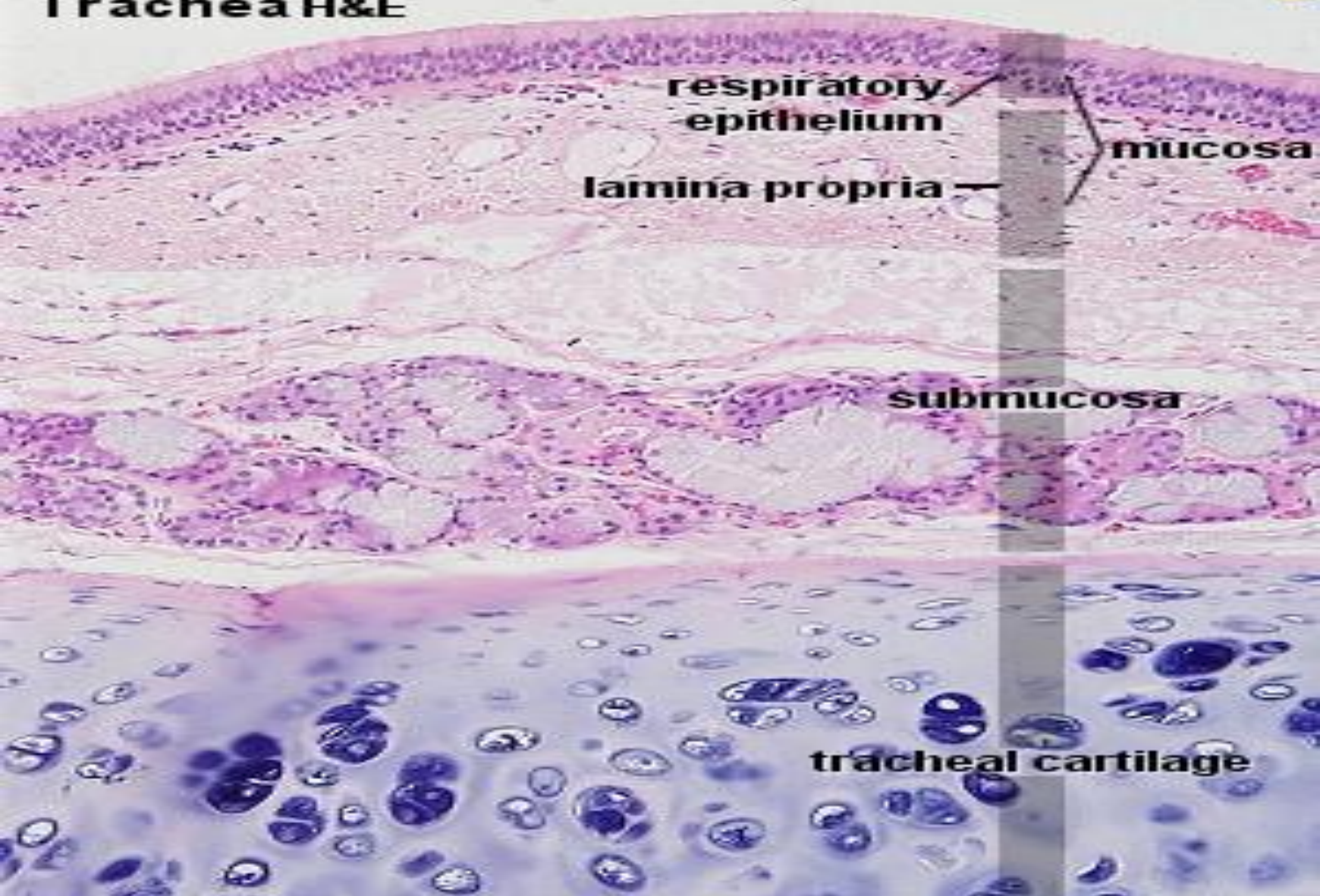
1- **Mucosa:**

- Respiratory epithelium.
- C.T corium.

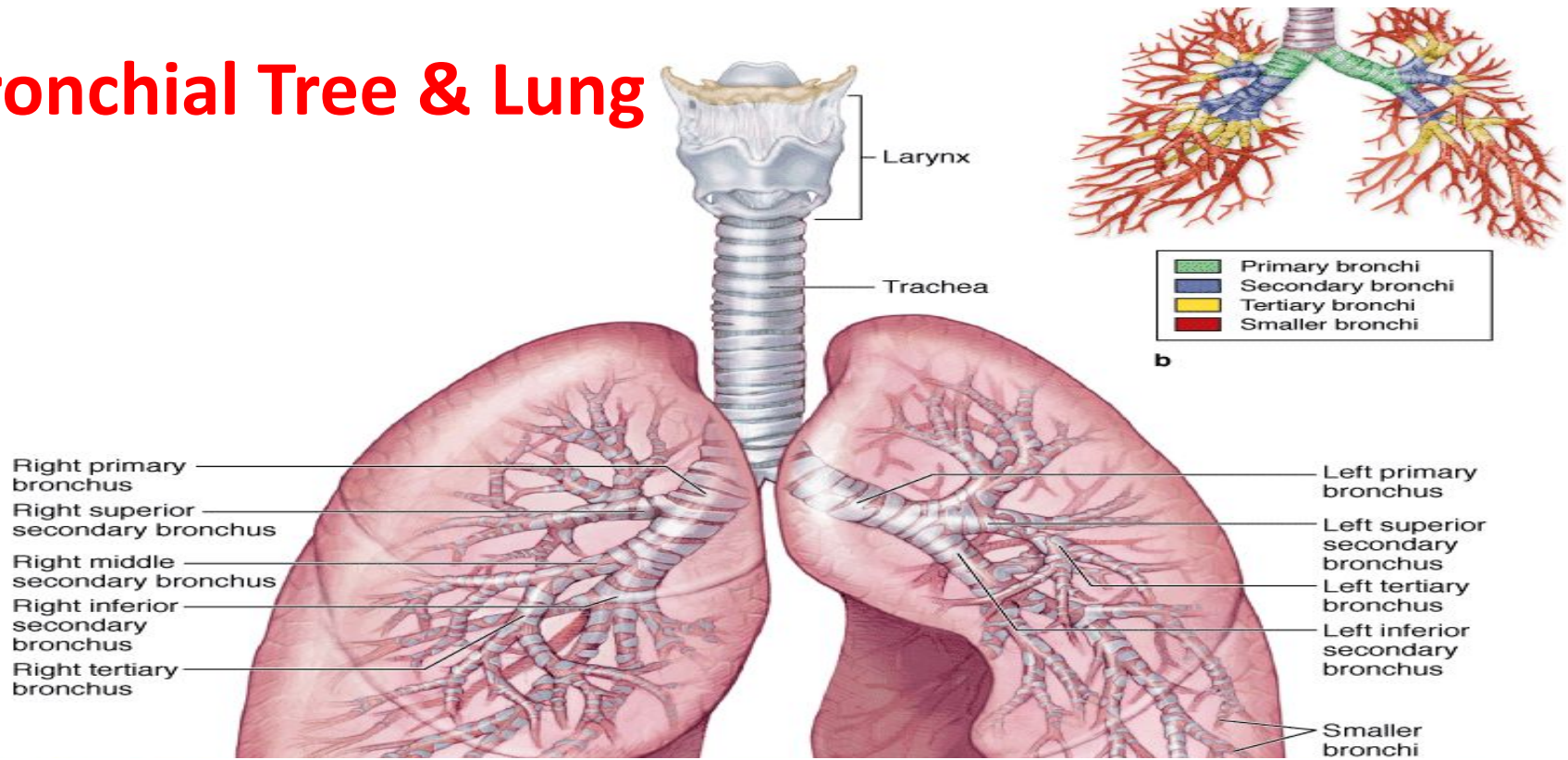
2- Submucosa: consists of loose C.T containing the tracheal (seromucous glands) glands.

3- Fibrocartilagenous coat of dense C.T, contain from 16-20 C-shaped rings of hyaline cartilage.

Trachea H&E



Bronchial Tree & Lung



The trachea divides into two primary bronchi that enter the lungs at the hilum, the **primary bronchi** course downward and outward, giving rise to **three secondary (lobar) bronchi in the right lung and two in the left lung**, each of which supplies a pulmonary lobe. These lobar bronchi again divide, forming **tertiary (segmental) bronchi**. Each of these tertiary bronchi, together with the smaller branches it supplies, constitutes a bronchopulmonary segment

BRONCHI

The walls of bronchi.1 contain irregular plates of cartilage and circular smooth-muscle fascicles bound together by elastic fibers

The number of goblet.2 cells and sub mucosa glands decreases from the trachea to the small .bronchi



Bronchioles

Bronchioles are the.1 intralobular airways with diameters of 5 mm or less, formed after about the tenth generation of branching, **and have neither cartilage nor glands in their . mucosa**

ciliated pseudostratified.2 columnar epithelium, decreases in height and complexity to become **ciliated simple columnar or cuboidal epithelium in the .smaller terminal bronchioles**

Goblet cells disappear during.3 this transition, replaced by **. Clara cells**



Bronchioles



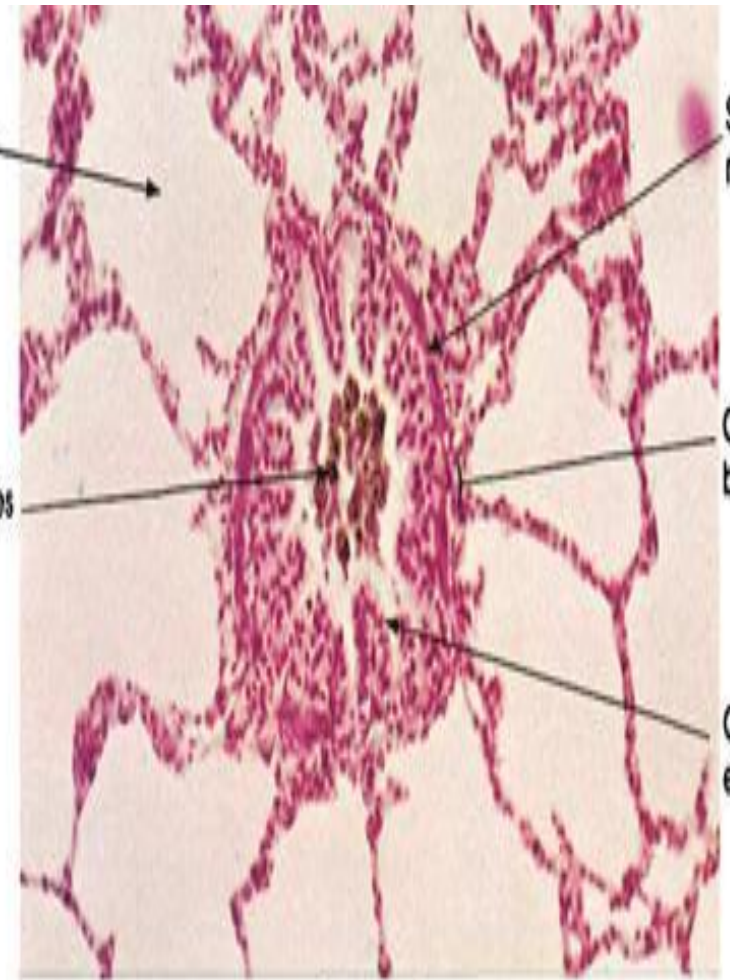
Ciliated pseudostratified columnar epithelium
Smooth muscle
Hyaline cartilage



Alveoli
Simple columnar epithelium

Smooth muscle
Constricted bronchiole
Hyaline cartilage
Seromucous gland

100 μ m



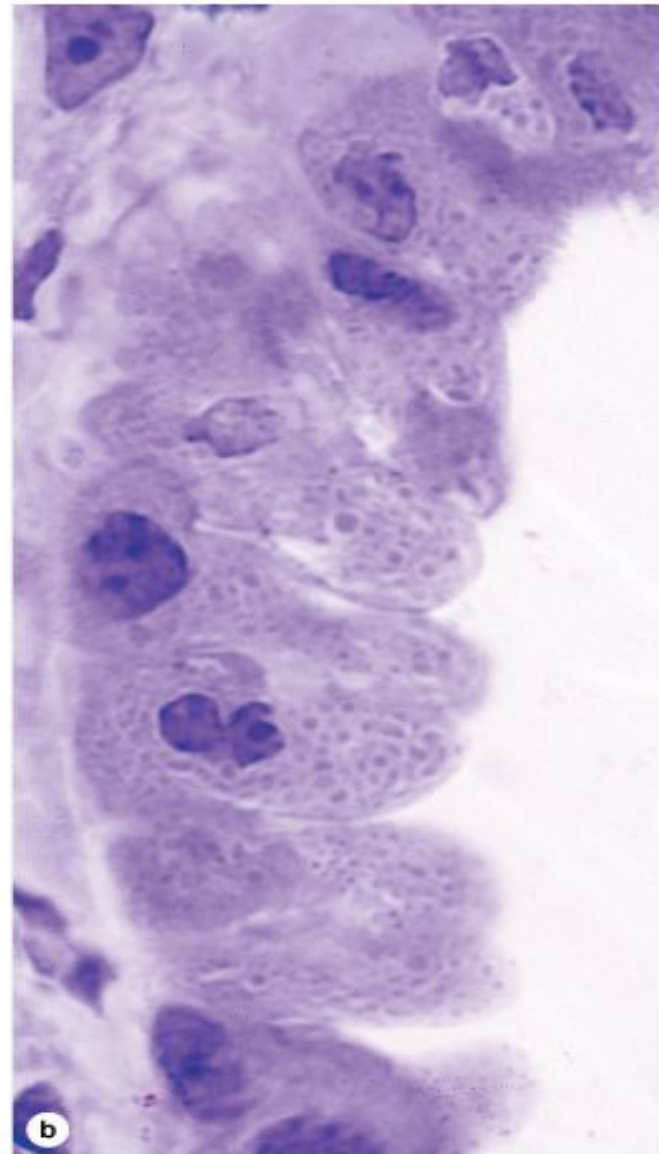
Alveoli
Macrophages

Smooth muscle
Constricted bronchiole
Columnar epithelium

100 μ m

Clara cells

cells These mitotically active.1
secrete surfactant.2
components
and have various important.3
.defensive roles
are most abundant in the.4
terminal bronchioles,
where
they make up about 80 % of
.the epithelial cell lining



Function of conducting portion

Dry air: moisten it by .1
.goblet cells and mucous

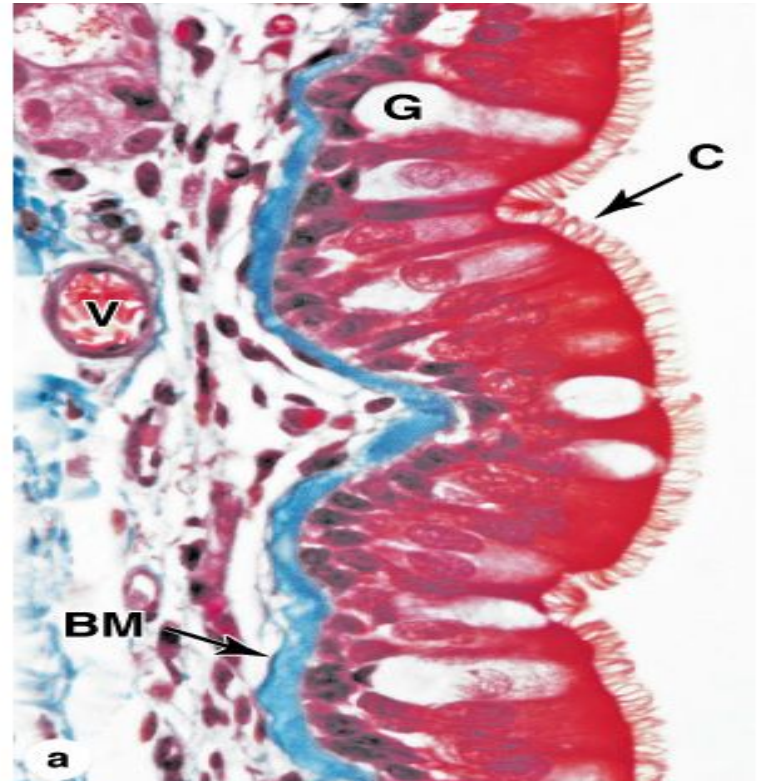
Particles: trap them .2
hairs, goblet cells and
.mucous

Particles: remove them .3
.cilia

Cold air: warm it blood .4
.vessels near epithelium

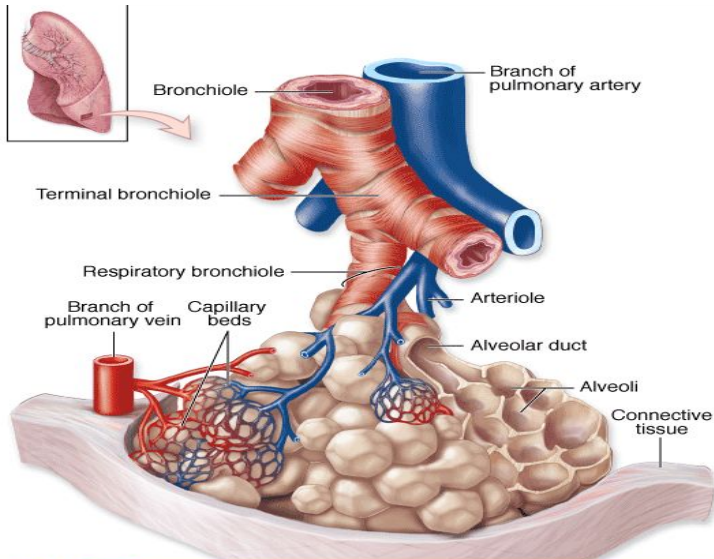
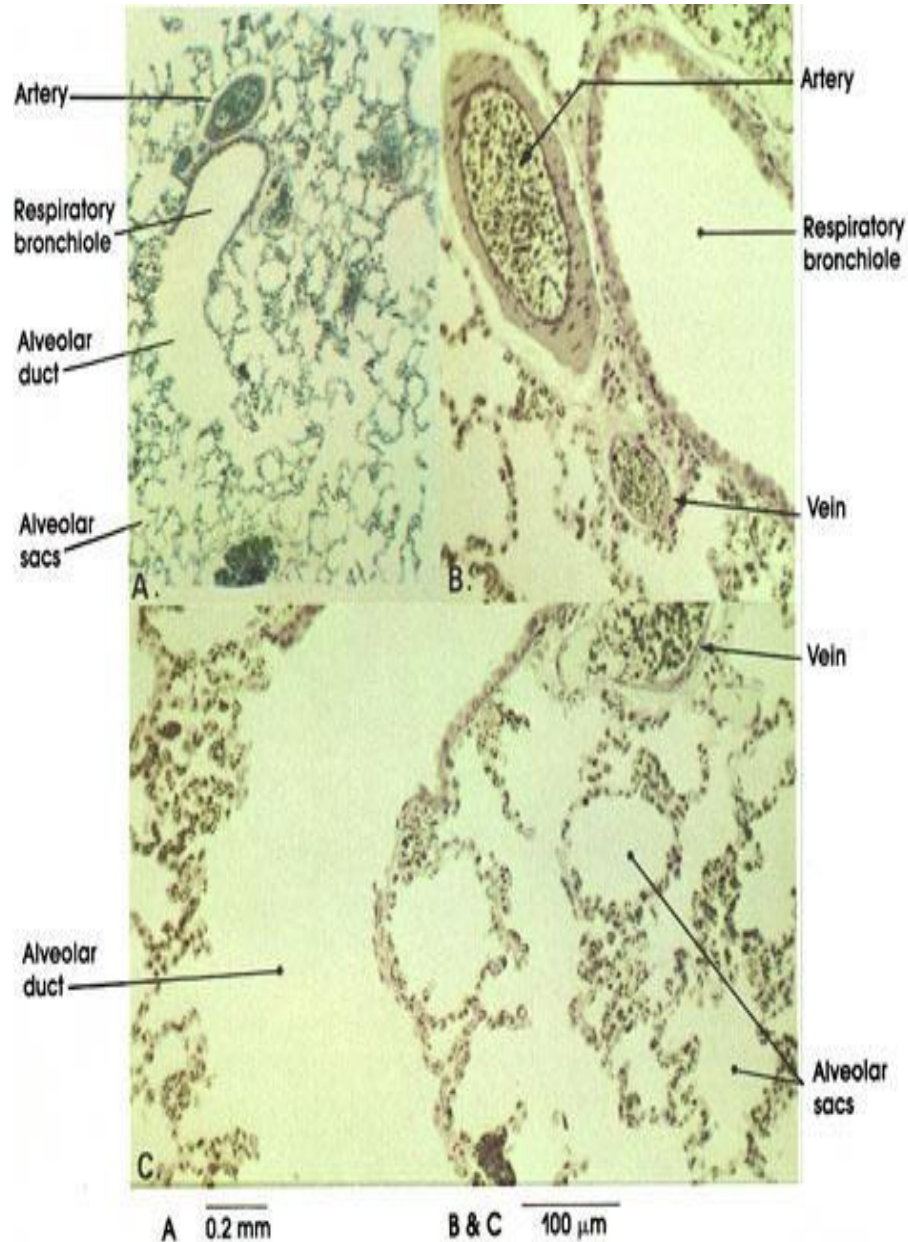
Bacteria: destroy them .5
lymphoid cells under the
epithelium

A combination of **cartilage**, **elastic** and **collagen fibers**, and **smooth muscle** provides the conducting portion with rigid structural support and the necessary flexibility and extensibility. To ensure an uninterrupted supply of air



Respiratory portion

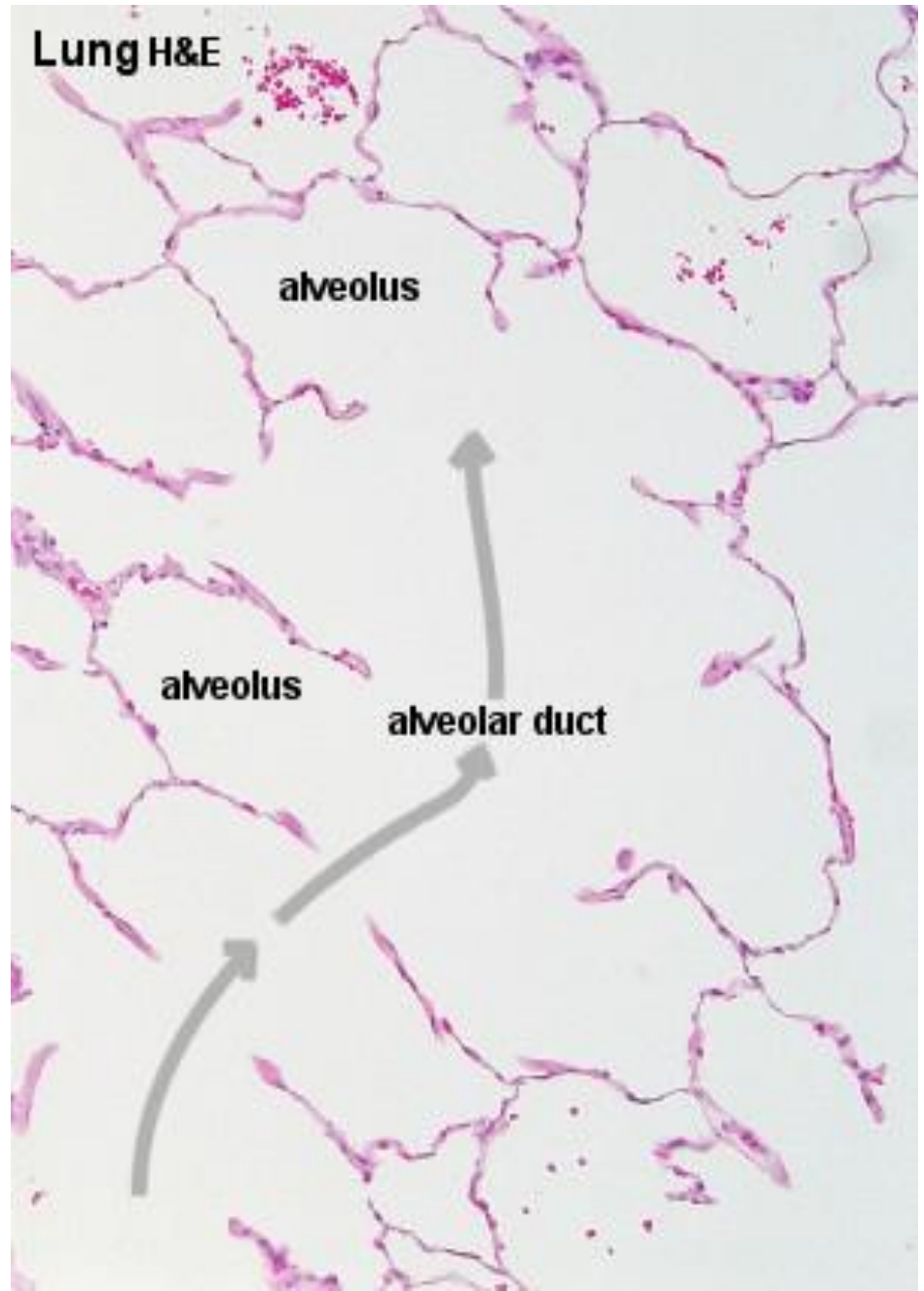
The respiratory bronchioles mucosa is structurally identical to that of the terminal bronchioles, except that their walls are interrupted by the openings to **alveoli**



Alveolar Ducts and sacs

Respiratory bronchioles.1
branch into tubes
called **alveolar ducts**
that are completely
lined by the openings
.of alveoli

Alveolar ducts open.2
into atria of two or
more **alveolar sacs**.
Elastic and reticular
fibers form a network
encircling the openings
of atria, alveolar sacs,
.and alveoli

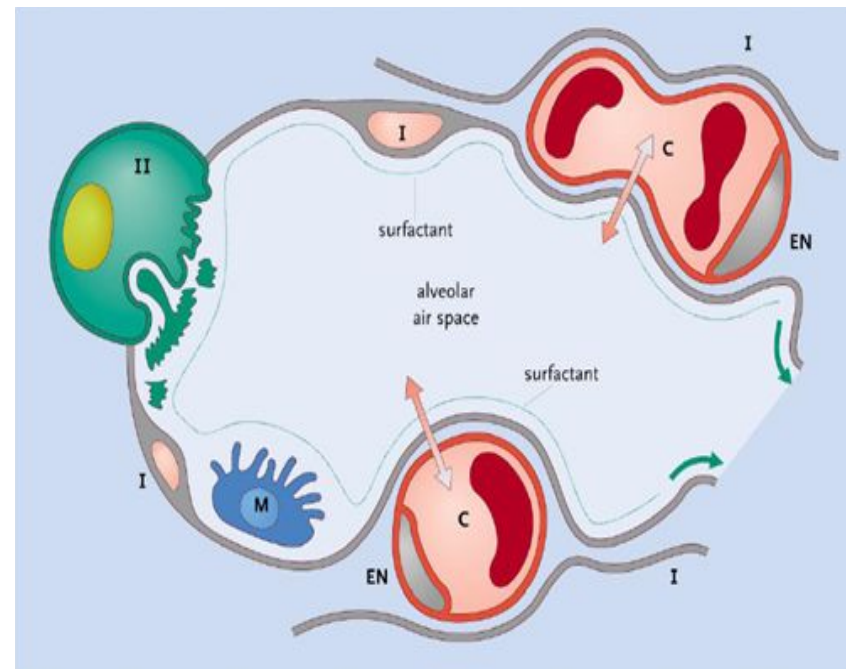


Alveoli

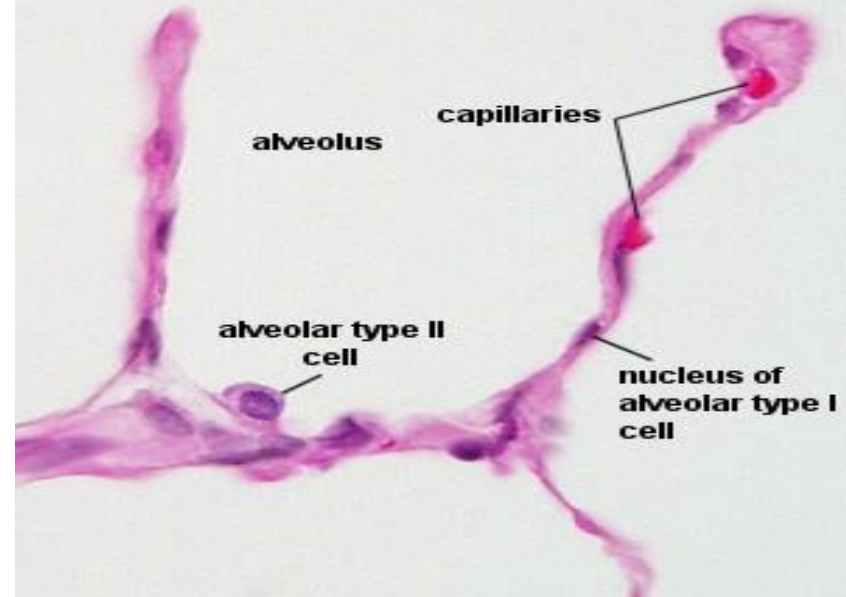
Alveoli are saclike evaginations.1 (about 200 μm in diameter) of the respiratory bronchioles, .alveolar ducts, and alveolar sacs

Structurally, alveoli resemble.2 small pockets that are open on one side. The structure of alveolar walls is specialized to enhance diffusion between the external and internal .environments

Interalveolar septum is wall lies.3 between two neighboring alveoli. These septa is vascularized with the richest capillary network in .the body



Lung H&E



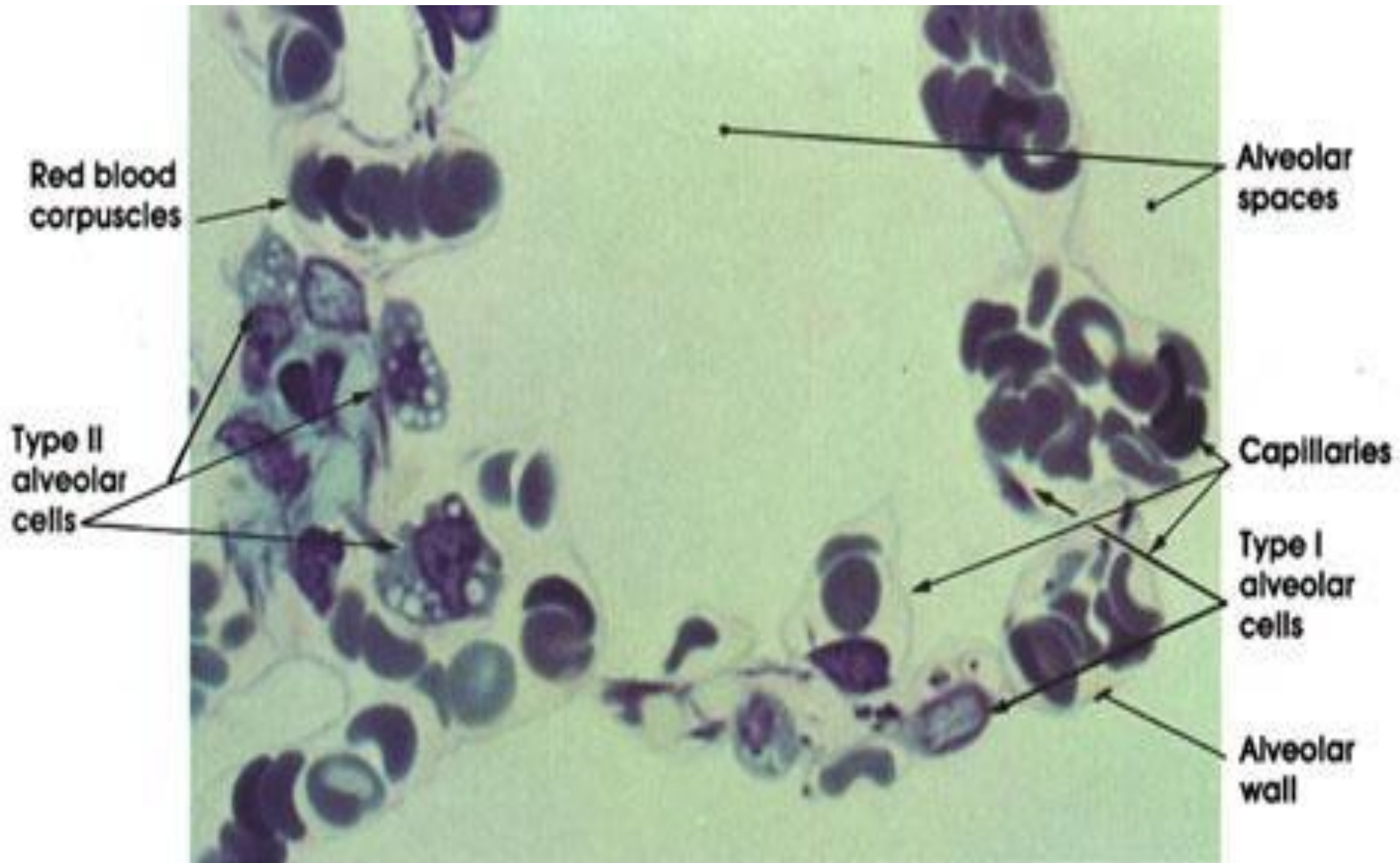
The cells of alveoli

Type I alveolar cells are extremely attenuated cells.**1** that line the alveolar surfaces. Type I cells cover 97% of the alveolar surface .The main role of these cells is to provide a barrier of minimal thickness .that is readily **permeable to gases**

Type II alveolar cells are rounded cells that often.**2** occur at points where the alveolar walls unite. give surface rise to the **pulmonary surfactant** that lowers tension

Alveolar macrophages .They **phagocytose**.**3** erythrocytes lost from damaged capillaries and air-borne particulate matter that has entered .alveoli

Alveoli



10 μm

blood-air barrier

Surface lining and cytoplasm of the alveolar.1
,cells

Fused basal laminae of the closely apposed alveolar.2
,cells and capillary endothelial cells

Cytoplasm of the endothelial cells.3

