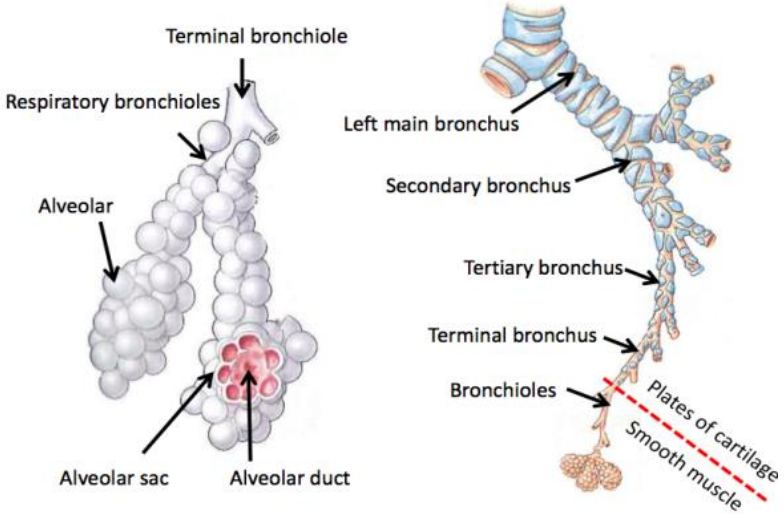
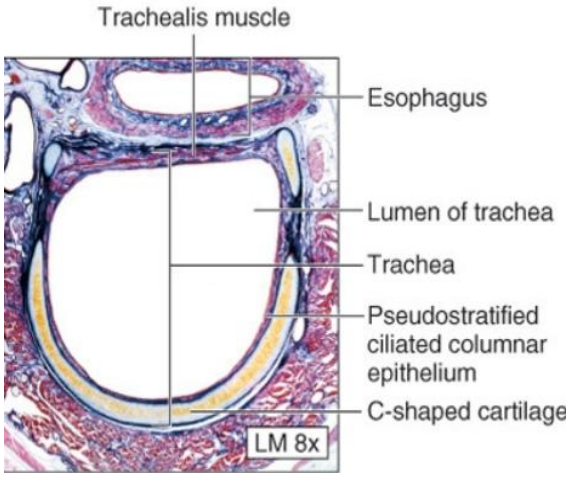
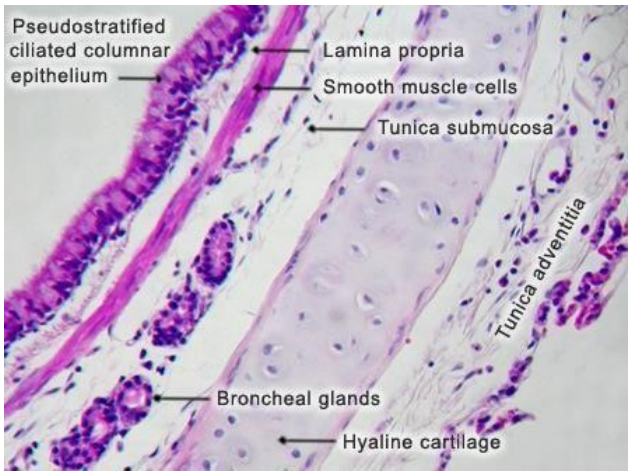
Unit II – Problem 4 – Histology: Tracheobronchial Tree

- **NOTICE THAT ANATOMY OF TRACHEOBRONCHIAL TREE HAS BEEN EXPLAINED IN ANOTHER NOTE PREVIOUSLY. IN THIS NOTE ONLY HISTOLOGY OF TRACHEOBRONCHIAL TREE WILL BE DISCUSSED.**
- **Trachea:**
  - It is a hollow tube, 10 cm in length and 2 cm in diameter.
  - It extends from the lower part of the larynx to its bifurcation to form a primary bronchus for each lung.
  - Most striking structure is the C-shaped hyaline cartilage rings (they develop at the anterior part of the trachea).
  - The free posterior ends of the C-shaped cartilages are interconnected by smooth muscle cells.
  - The epithelium is pseudo-stratified columnar ciliated epithelium with goblet cells.



  - Under the epithelial cells, there are basal cells which function as stem cells for the ciliated and goblet cells.
  - **Tracheal epithelial cell types:**
    - ✓ Columnar cells: extend from the basal membrane to the luminal surface. These cells contain cilli (important to move the mucus) and microvilli.
    - ✓ Goblet cells: they secrete a polysaccharide mucus material into the lumen of the trachea, supplemented by secretions of the submucosal mixed glands → aiming to provide a mucosal layer.
    - ✓ Basal cells: stem cells for the ciliated and goblet cells and they give the pseudo-stratified appearance.
    - ✓ Pulmonary neuroendocrine cells: which produce hormones.

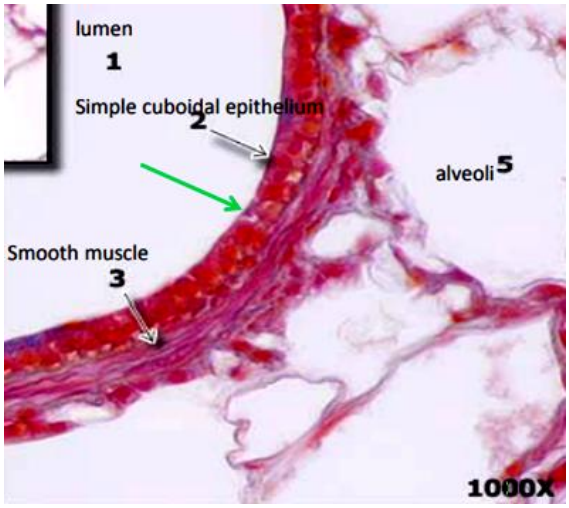




  - **Clinical correlates:**
    - ✓ If mucosal clearance is ineffective or the mechanism overwhelmed, infection (pathogenic bacteria) or pneumoconiosis may follow.
    - ✓ In cystic fibrosis there is a defect in the chloride transport mechanism resulting in a thick secreted mucus → cilia will have difficulty in moving it toward the pharynx, Patients with this disease have frequent infections of the respiratory tract.

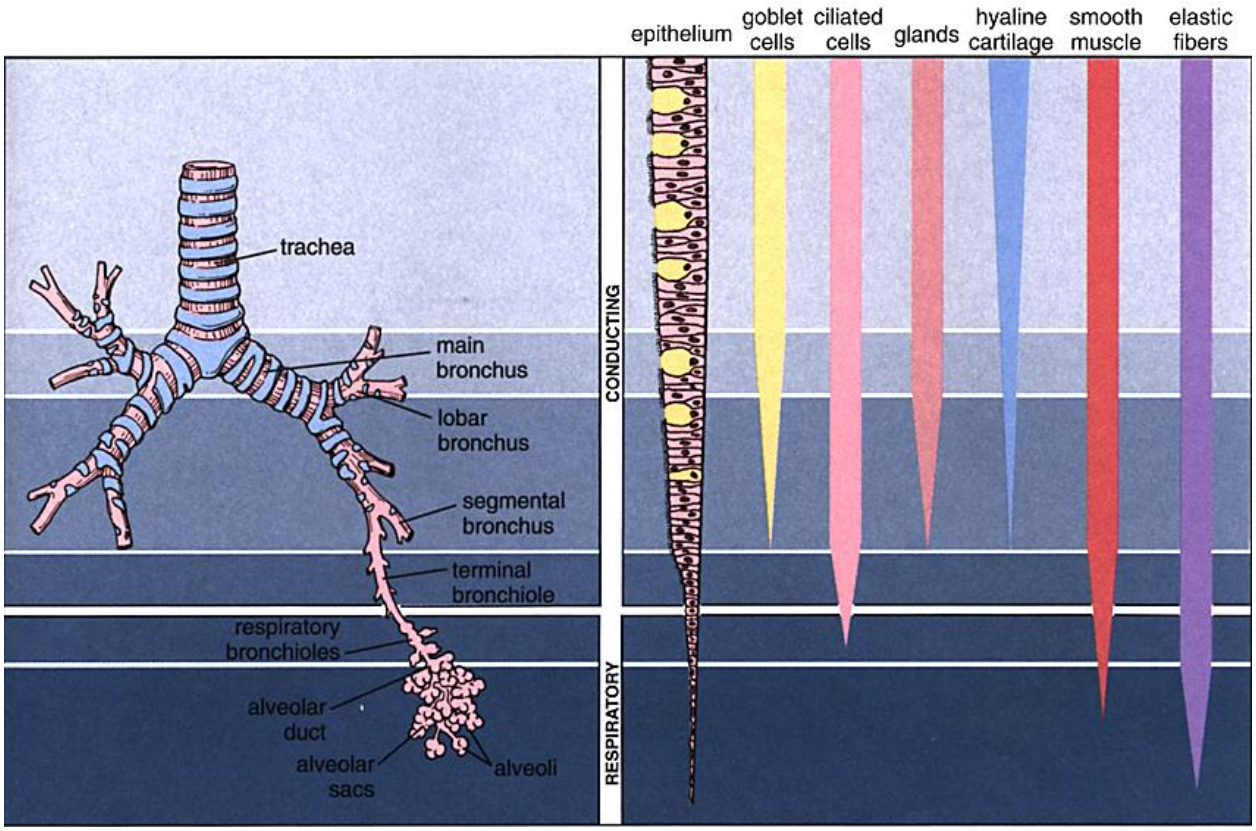
- **Columnar and goblet cells are sensitive to irritation:**
  - ✓ The ciliated cells become taller and there is an increase in the number of goblet cells submucosal glands. Intensive irritation from smoking leads to a squamous metaplasia where the ciliated epithelium becomes a squamous epithelium (this process is reversible).
- Bronchial metastatic tumors arise from neuroendocrine cells.
- Bronchi have irregular plates of cartilage surrounded by ciliated epithelium and lamina propria still has submucosal glands.

- **Bronchioles:**
  - The wall of a bronchial has no more cartilage or sero-mucus glands.
  - The smooth muscle fascicles are bound together by elastic fibers (surrounding the bronchiole).
  - The epithelium is still ciliated, but is a simple cuboidal or columnar epithelium rather than pseudostratified.
  - **The epithelial lining of the airway is composed of ciliated cells (goblet and basal cells are absent in the bronchioles) and additional type called Clara cell (mainly in terminal bronchioles):**



    - ✓ They are non-ciliated and secrete serous solution similar to surfactant.
    - ✓ They aid in the detoxification of airborne toxins and serve as stem cells for the ciliated cells and for themselves.
    - ✓ The number of Clara cells increase in response to increased levels of pollutants like cigarettes.
    - ✓ They are most abundant in the terminal bronchioles (where they make up about 80% of the epithelial cells lining). They are also involved in Cl- transport into the lumen of the terminal bronchioles.
    - ✓ At the end of terminal bronchioles, respiratory bronchioles start (also with cuboidal epithelium).
  - **Clinical correlates:**
    - ✓ Cystic fibrosis results in abnormally thick mucus due to defective Cl-transport by Clara cells.
    - ✓ COPD affects the bronchioles and includes emphysema and asthma. Emphysema is caused by loss of elastic fibers and results in chronic airflow obstruction. Asthma is a chronic process characterized by a reversible narrowing of airways. Asthma is reversible while emphysema is not.

- **Terminal bronchioles:**
  - Last conducting bronchiole.
  - Followed by respiratory bronchiole which is interrupted by alveoli in its wall.
  - Goblet cells are absent from the epithelial linings of respiratory bronchioles but they are still lined with a sparse ciliated cuboidal epithelium that prevents the movement of mucus into alveoli.
  - After the respiratory bronchiole, the wall of the airway disappears and air enters alveoli.


epithelium
goblet cells
ciliated cells
glands
hyaline cartilage
smooth muscle
elastic fibers
trachea
main bronchus
lobar bronchus
segmental bronchus
terminal bronchiole
respiratory bronchioles
alveolar duct
alveolar sacs
alveoli
CONDUCTING
RESPIRATORY