RESPIRATORY SYSTEM
NASAL CAVITY
LARYNX
PHARYNX
TRACHEA
BRONCHI
BRONCHIOLES
LUNGS

RESPIRATORY SYSTEM
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• Ventilating mechanism
• Conducting portion
• Respiratory part
Ventilating mechanism

**Muscles of inhalation**
- Sternum muscles elevate upper ribs and sternum
- Intercostals elevate the ribs
- Diaphragm flattens increasing volume of thoracic cavity

**Muscles of exhalation**
- Intercostals pull ribs down
- Abdominals compress diaphragm thus pulling it up and increasing volume of thoracic cavity
Mechanism of Breathing
Conducting portion (respiratory passages)

Extrapulmonary
- Nasal Cavity
- Larynx
- Trachea
- Primary bronchi

Inrapulmonary
- Bronchi
- Bronchioles
- Terminal bronchioles
Structure of the wall

- Adventitia
- Fibro-cartilage plate
- Mucosa (epithelium, lamina propria)
Respiratory Epithelium
Pseudostratified columnar ciliated

Ciliated cells:
• Ion transport and movement of trapped particles

Goblet cells: mucous secretion

Basal cells: regeneration

Neuroendocrine cells:
Hormones regulating respiratory functions
Other cell types of respiratory epithelium

- Langerhans cells
  - Ag-presenting cells in the epithelium of trachea and bronchi

- Brush cells
  - sensory receptor cells
Respiratory Mucosa

- Pseudostratified respiratory epithelium
- Cilia
- Goblet cell

Connective tissue
Gland
Nasal cavity
Mucus
Particle
Pharynx
Epithelial cell
Goblet cell
The structure of the respiratory epithelium at different sites within the respiratory tract

A respiratory mucosa, with mucous cells and the mucus escalator, lines the nasal cavity and the superior portion of the pharynx.

A stratified squamous epithelium lines the inferior portions of the pharynx, protecting the epithelium from abrasion and chemical attack.

A typical respiratory mucosa lines the conducting portion of the lower respiratory tract.

In the finer bronchioles, the epithelium becomes cuboidal.

The gas exchange surfaces consist of a delicate simple squamous epithelium. Here the distance between the air and the blood in adjacent capillaries is generally less than 1 μm.
Changes in the structure of the wall of bronchial tree with decrease of its diameter

• Decrease of cartilage size until it fully disappears in the wall of bronchioles
• Increased number of smooth muscle cells
• Increased number of elastic fibers
• Decrease of the epithelial cell height
• Goblet cells disappear in terminal bronchioles
• Ciliated cells disappear
Trachea

- "Adam's apple"
- Thyroid cartilage
- Cricoid cartilage
- Trachea
- Tracheal cartilages
- Primary bronchi

Blood vessels
Respiratory epithelium
Hyaline cartilage
Tertiary bronchus

Bronchioles
Terminal bronchiole
Respiratory part (gas exchange)

- Trachea
- Main bronchus
- Bronchioles
- Terminal bronchioles
- Respiratory bronchioles
- Acinus
- Alveolar sacs
- Alveolus
Acinus

- End-point of respiratory tree
- Structures that contain air-exchange chambers are called alveoli
- Respiratory bronchioles lead into alveolar ducts: walls consist of alveoli
- Ducts lead into terminal clusters called alveolar sacs – are microscopic chambers
- There are 3 million alveoli!
Respiratory bronchiole
Alveolar cell types

- Type I Alveolar cell
- Type II Alveolar cell
- Alveolar macrophages
Type I Alveolar cell

- 97% of alveolar cells
- Functions:
  - Blood-air barrier formation
  - Surfactant turnover
Type II Alveolar Cell

- **Surfactant** — phospholipids, proteins and carbohydrates emulsion

- **Functions:**
  - Decrease of surface tension
  - Activation of alveolar macrophages
  - Opsonisation of bacteria
Alveolar macrophage

- 10–15% of cells in the alveolar septa
- Bone marrow derived
- Remove debris that escaped mucous and cilia in the conducting portion
Macrophage (AP) + alveolar cells I and II
Capillaries surrounding alveoli
Blood-air barrier:

- Endothelial cells cytoplasm
- Basement membrane (common for alveolar cells and epithelial cells)
- Type I alveolar cells cytoplasm
- A thin film of surfactant
Blood-air barrier
Blood supply

Functional circulation (pulmonary)
- Right ventricle - Pulmonary arteries – gas exchange – pulmonary veins - Left atrium

Systemic circulation (nutrient)
- Bronchial arteries from thoracic aorta
Sympathetic and parasympathetic stimulation of smooth muscle cells and glands in the bronchial wall