CHAPTER 23
The Respiratory System

Functions of the Respiratory System

- Gas Exchange (Respiration)
  - Eliminates CO₂
  - Brings in O₂
  - Regulates pH
  - Filters inhaled Air
  - Produces sound
  - Contains receptors for olfactory system

Respiration – 3 basic steps

- Pulmonary ventilation
  - Gas exchange between the atmosphere and lungs
- External (pulmonary) respiration
  - Gas exchange between the alveoli & blood in the pulmonary capillaries
- Internal (tissue) respiration
  - Gas exchange between blood and the tissues

Respiratory Passageways
Bronchial tree (trachea to alveoli)

- Trachea
- Primary bronchi
- Secondary (lobar) bronchi
  - 1 for each lobe (right lung has 3, left lung has 2)
- Tertiary (segmental bronchi)
  - Each supplies a bronchiopulmonary segment
- Bronchioles
  - Contains smooth muscle and no cartilage
- Terminal bronchioles
- Respiratory bronchioles (simple squamous epith.)
- Alveolar ducts (atria)
- Alveoli
**Structural Classification**

- Upper Respiratory System
  - Nose
  - Pharynx
- Lower Respiratory System
  - Larynx
  - Trachea
  - Bronchi
  - Bronchial Tree
  - Lungs

**Functional Classification**

- Conducting portion
  - Nose
  - Pharynx
  - Larynx
  - Trachea
- Respiratory portion
  - Where gas exchange occurs
  - Respiratory bronchioles
  - Alveolar ducts alveolar sacs
  - Alveoli
Serous Membrane

- Pleura
  - Parietal pleura
    - Membrane lining the thoracic cavity
  - Visceral pleura
    - Membrane covering the lung
  - Interpleural space
    - A potential space (contains fluid)
- Pleurisy
  - Inflammation of the pleura
- Pneumothorax
  - Air in the interpleural space
- Atelectasis

Cell types in the lung

- Type I alveolar cells
  - Simple squamous epithelium
  - Forms a continuous lining for gas exchange
- Type II alveolar cells (septal cells)
  - Secrete alveolar fluid (surfactant)
    - Reduces surface tension
    - Respiratory distress syndrome (premee babies)
- Dust cells (macrophages)
- phagocytosis

Respiratory membrane

- ½ μm thick = 1/16 the diameter of RBC
- Surfactant layer
- Type I alveolar cell
- Epithelial basement membranes
  - Alveolar cell basement membrane
- Capillary basement membrane
- Capillary endothelium
**Pulmonary Ventilation**

- Exchange of gases between the atmosphere and the lungs
  - Inspiration
    - Moving air into the lungs
  - Expiration
    - Moving air out of the lungs

**Boyles Law**

- At a constant temperature the pressure of a gas in a closed container is inversely proportional to the size of the container.
  - ↑ Volume - ↓ Pressure
  - ↓ Volume - ↑ Pressure

**Muscles of Inhalation**

- Quiet Breathing
  - Diaphragm
  - External intercostals

- Strenuous Inhalation
  - Sternocleidomastoid – elevates sternum
  - Scalenes – elevates ribs 1 & 2
  - Pectoralis minor – elevates ribs 3-5

**Pressure Changes During Quiet Inhalation**

<table>
<thead>
<tr>
<th></th>
<th>Before inhalation</th>
<th>During inhalation</th>
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</thead>
<tbody>
<tr>
<td>Atmos. Pressure</td>
<td>760</td>
<td>760</td>
</tr>
<tr>
<td>Intrapleural press.</td>
<td>756</td>
<td>754</td>
</tr>
<tr>
<td>Alveolar Pressure</td>
<td>760</td>
<td>758</td>
</tr>
</tbody>
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**Expiratory Muscles**

- Normal (quiet) expiration is a passive process. Results from relaxation of the inspiratory muscles.
  - ↓ Volume - ↑ Pressure

- Forced Expiration: (muscles that pull the rib cage down)
  - Abdominal group
  - Internal intercostals
Lung Volumes

- **Tidal Volume (TV)**
  - Amt that moves in or out in a normal breath
- **Inspiratory Reserve Volume (IRV)**
  - Amt that we can forcefully inhale above TV
- **Expiratory Reserve Volume (ERV)**
  - Amt we can forcefully exhale beyond the TV
- **Residual Volume (RV)**
  - Amt that remains after ERV is exhaled

Lung Capacities

- **Vital Capacity**
  - \( VC = IRV + ERV + TV \)
- **Lung Capacity**
  - \( LC = IRV + ERV + TV + RV \)

Anatomic Dead Space

- Airspace that does not participate in gas exchange
- Units given in milliliters and is approximately equal to your weight in pounds (normal weight individual) e.g. 140 mls if you weigh 140 lbs

Learning Objectives

- Discuss the functions of the respiratory system
- Name the basic steps in Respiration
- Name the structures in the upper and lower respiratory tracts
- Describe the conductive vs. the respiratory portions of the system
- Describe the serous membranes of the respiratory system

Learning Objectives

- Describe the trachea and tracheal cartilages
- Describe the bronchial tree and the changes in epithelium, muscle and cartilage
- Describe lung lobes and bronchio-pulmonary segments for each lung
- Define the following terms: pleura, pneumothorax and atelectasis
<table>
<thead>
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<th>Learning Objectives</th>
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<tr>
<td>Describe the Type I and Type II alveolar cells</td>
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<tr>
<td>Describe the dust cells</td>
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<tr>
<td>List the components of the respiratory membrane</td>
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<tr>
<td>Discuss Boyle’s Law</td>
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<td>Which muscles are involved in quiet vs. forceful inspiration and expiration</td>
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<td>Discuss the approximate pressures involved in pulmonary ventilation</td>
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<td>Describe the different lung volumes and capacities</td>
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<td>Describe Anatomic Dead Space</td>
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