Respiratory System Mechanics

Anatomy of the Respiratory System

- nasal cavity
- pharynx
- trachea
- lungs
- heart
- diaphragm

Alveoli

- bronchiole
- alveoli
- capillaries

An Alveolus

- alveolar macrophage
- type I alveolar cell
- type II alveolar cell
- pulmonary capillaries
Lung Ventilation

Inhalation

Exhalation

Lungs in Pleural Cavity

Pleural Linings

Lung Volumes

Tidal Volume (TV)

Inspiratory Reserve Volume (IRV)

Expiratory Reserve Volume (ERV)

Residual Volume (RV)

Lung Volumes

 Inspired Volume

Residual Volume

Expiratory Reserve Volume

Tidal Volume

Inspiratory Reserve Volume
Lung Volumes

Vital Capacity (VC)
VC = TV + IRV + ERV

Total Lung Volume (TLV)
TLV = VC + RV

Pulmonary Function Tests

Forced Vital Capacity (FVC)
The amount of air that can be expelled when the subject takes the deepest possible breath and exhales as completely and rapidly as possible.

Forced Expiratory Volume (FEV₁)
Measures the percentage of the vital capacity that is exhaled during 1 second of the FVC test.
Factors Affecting Respiration

Simulating Variations in Breathing

Carbon Dioxide Chemistry in the Blood

\[ \text{CO}_2 + \text{H}_2\text{O} \rightleftharpoons \text{H}_2\text{CO}_3 \]

carbonic acid

enzyme = carbonic anhydrase

Carbon Dioxide Chemistry in the Blood

\[ \text{H}_2\text{CO}_3 \rightleftharpoons \text{HCO}_3^- + \text{H}^+ \]

carbonic acid ion hydrogen ion

Acids

\[ \text{HCl} \rightleftharpoons \text{H}^+ + \text{Cl}^- \]

Bases

\[ \text{NaOH} \rightleftharpoons \text{Na}^+ + \text{OH}^- \]
pH Scale

\[ pH = -\log[H^+] \]

<table>
<thead>
<tr>
<th>Type of Solution</th>
<th>pH Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral</td>
<td>7</td>
</tr>
<tr>
<td>Acidic</td>
<td>&lt;7</td>
</tr>
<tr>
<td>Basic (alkaline)</td>
<td>&gt;7</td>
</tr>
</tbody>
</table>

Acid/Base Balance

Normal pH Range: 7.35 - 7.45

acidosis versus alkalosis

Regulation of Breathing

Acidic
- Hydrochloric Acid
- Stomach Acid
- Lemon Juice
- Cola Drinks
- Tonic Water
- Black Coffee
- Vinegar
- Pure Water
- Sea Water
- Baking Soda
- Baking Powder
- Acetic Acid
- Hydrochloric Acid
- Household Ammonia
- Household Bleach (10:5)
- Oven Cleaner (1:5)
- Sodium Hydroxide