Physics Applicable to Respiratory System

Respiratory system

- Upper Tract: Nose, pharynx & associated structures
- Lower Tract: Larynx, trachea, bronchi & lungs
- Respiratory zone: site of gas exchange
- Conducting zone: rigid conduits
- Respiratory muscles

Mechanics of breathing

- Inspiration (inhalation): air flows into the lungs
- Expiration (exhalation): gases exit the lungs

Basic atmospheric conditions

- Atmospheric pressure: **760 mmHg**
- Composition of the atmosphere: Nitrogen = 78%; Oxygen = 21%; Carbon dioxide = 0.038%

Dalton's Law (Law of Partial Pressures)

- The total pressure of a mixture of non-reacting gases is equal to the sum of the pressures of the individual gases

Fick's Laws of Diffusion

- Solute moves from region of high concentration to low concentration (at a rate which is directly proportional to the concentration gradient)

Boyle's Law

- Pressure & volume of a gas in a system are inversely related ($\mathbf{P_1V_1 = P_2V_2}$)
  Breathing: Thoracic volume changes → pressure changes → flow of gases to equalize pressure
  - **Diaphragm** movement → change in length of thoracic cavity
  - **Rib cage** movement → change in circumference of thoracic cavity

Pressure relationships in the thoracic cavity

- Atmospheric pressure (P_{atm}): Pressure exerted by the air surrounding the body
- Intrapulmonary pressure (P_{alv}): Pressure within the alveoli
- Intrapleural pressure (P_{ip}): Pressure within the pleural cavity
- P_{alv} (1) always equalizes itself with P_{atm} eventually; (2) is always higher than P_{ip}
- P_{alv} and P_{ip} fluctuate with the phases of breathing

Pulmonary function test

- Spirometer: to measure the volume & rate of air inspired & expired by the lungs

Ideal Gas Law

- Pressure & volume of a container of gas is directly related to the temperature of the gas & number of molecules in the container (**PV = nRT**)