Respiratory Mechanics

RESPIRATORY MECHANICS - VENTILATION

Functions of Respiratory System:
Bring in oxygen: fuels cell metabolic activity.Release carbon dioxide: rids body of metabolic waste.Regulate blood pH: via regulation of blood oxygen and carbon dioxide concentrations.
Three major components:
1. Muscular and skeletal components of the chest wall: the "pump".2. Alveoli = interfaces for gas exchange ("gas exchanger").3. Areas of the brain that stimulate respiratory function (the controller").
Boyle's Law and The Respiratory System:
Boyle's law describes the relationship between the pressure and volume of a gas; it dictates the mechanics of respiration.Boyle's Law Equation: (P1)(V1) = (P2)(V2) Pressure and volume of a gas are inversely related (assume
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Changes in altitude & atmospheric pressure:
To show Boyle's law in a real-world example, draw a mountain and then draw a balloon at the base of it. The base of the mountain is a region of high pressure.Next, show that you carried the balloon to the top of the mountain; indicate that this is a region of lower pressure.Assuming temperature is constant, at the base and top of the mountain (which, of course it isn't), what happens to the balloon?It expands because its volume increased as the atmospheric pressure

KEY ANATOMICAL/MECHANICAL STRUCTURES

Lungs sit within a double-walled pleural sac, which separates lungs from thoracic wall.Pleural space, which is the potential space within sac.Sternum and ribs around pleural sac. The internal and
Diaphragm comprises a sheet of skeletal muscle and forms bottom
Contraction/relaxation changes the volume of the thoracic cavity, which alters the intrapulmonary and intrapleural pressures in accordance with Boyle's law.
AIR PRESSURES
Changes in air pressures dictate movement of air during inspiration and expiration. Atmospheric pressure = 760 mm Hg, external to the thoracic cavity.Intrapulmonary pressure (intra-alveolar pressure) = atmospheric pressure at rest, refers to the pressure within the lungs Intrapleural pressure = 756 mmHg, pressure in the pleural space.
Inspiration: Actively increases thoracic volume
Movements during Inspiration:Diaphragmatic Contraction: Diaphragm flattens and moves inferiorly as it contracts.External Intercostal Muscle Contraction: Forces sternum to move in an anterior and superior direction.Effects as thoracic volume increases: – Intrapulmonary pressure decreases to below atmospheric pressure; creates pressure gradient that facilitates inhalation. – Air moves down this pressure gradient: Moves from atmosphere (high P) through trachea into lungs (low P) Gas exchange occurs in lungs ? need to exhale carbon dioxide.
~~temperature is constant).~~
Expiration: Passively decreases thoracic volume
Movements during Expiration: Diaphragm relaxes. Ribs back to resting position (move medially).External intercostal muscles relax. Sternum back to resting position (moves inferiorly).Effects as thoracic muscles relax:Lungs elastically recoil to their pre-inspiratory volume; Lung volume decreases.Intrapulmonary pressure increases above atmospheric pressure; creates pressure gradient that facilitates expiration. Air moves down pressure gradient: Moves from lungs ? out trachea ? into atmosphere, CO_2 exhaled.
Compliance

decreased.

Flow Rate