Respiratory System

Introduction, Mechanics of Respiration, and Ventilation

I. Introduction: Describe how the cardiovascular and respiratory systems interact to supply O$_2$ and eliminate CO$_2$.

A. All cells need oxygen and release carbon dioxide—why?

B. Two systems that help to supply O$_2$ and eliminate CO$_2$
   1.
   2.

C. Functions of the respiratory system
   1. Functions of the nose
   2. Sound (phonation/vocalization)
   3. Conduction of air
   4. Gas exchange (external and internal respiration)
   5. Barrier functions
   6. Regulation of blood pH
   7. Metabolic functions (non respiratory—remember ACE???)
   8. Non-specific immunity

D. Processes of respiration
   1. Pulmonary Ventilation
   2. External Respiration
   3. Internal Respiration

II. Anatomy of the respiratory system—Use your Lab notes. You must know the organs of the respiratory system, their structures, histology, and their functions in order to understand the physiology of the respiratory system that follows.

A. Review the respiratory pathways (see supplemental handout).

B. Look at the respiratory tree: Compare the conduction zones and the respiratory zones—relate them to pulmonary ventilation, external respiration, and internal respiration. Compare the histology of each area and relate it to its function. How does asthma fit into this picture, anatomically?

C. Alveoli—histology and functions (Fig. 23.11 a and b, pg. 860)
   1. Alveolar ducts
   2. Alveolar sacs
   3. Alveoli (Copy Fig. 23.12—it is mandatory for C & D)
      a. Type I cells (simple squamous epithelial cells)
      b. Type II cells (septal cells)—surfactant
      c. Type III cells (alveolar macrophages/dust cells)—phagocytosis
      d. Elastic fibers in basement membrane
   4. Asthma: describe asthma and how does it apply at this level?
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D. Respiratory membrane (what do gases go through?) and external respiration

E. Diagrammatically represent the anatomy and functional aspects of the respiratory system. Include the following and describe each.
   1. Ventilation
   2. Conducting airways
   3. External respiration
   4. Alveoli
   5. Blood-gas barrier
   6. Capillaries
   7. Internal respiration
   8. Tissues
   9. Metabolic functions

III. Barrier Function: Describe various factors involved with the barrier function of the respiratory system.

A. Conductive zone
B. Goblet cells and mucous glands
C. Mucous raft
D. Macrophages
E. Pinocytosis
F. Lymphatics
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IV. Mechanics of Respiration: Describe the respiratory mechanisms based on pressure gradients and gas laws (especially Boyle’s). Define and apply the terms atelectasis and compliance. Relate this to obstructive and restrictive pulmonary diseases/disorders.

A. Three processes of respiration
   1. Ventilation
   2. External respiration
   3. Internal respiration

B. Review anatomy—note relationship between pleura and lungs and diaphragm (see Fig. 23.10a).

C. Pulmonary Ventilation and muscles of respiration (See Fig. 23.14)
   1. Diaphragm
   2. External intercostals
   3. Internal intercostals

D. Inspiration
   1. Definition
   2. Boyle's Law
   3. Pressure gradient
      a. Intrathoracic pressure
      b. Intrapleural (between parietal pleura and visceral pleura)
      c. Intraalveolar (intrapulmonic) pressure
   4. What is the direction of the pressure gradient?
   5. Active process (energy required)

E. Expiration
   1. Definition
   2. Pressure gradient
   3. Passive process
   4. When is this an active process?
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- See supplemental handout: Major Events Leading to Inspiration and Expiration.

- Review Figs. 23.15 & 23.16—Overview of pressure changes and summary of events.

F. Atelectasis
   1. Definition

   2. Why do alveoli have a "tendency" to recoil inward on themselves or "snap back"?

   3. What factors enhance elastic recoil (atelectasis) of alveoli?
      a. Recoil of elastic fibers
      b. Surface tension pulls inward
      c. Does this enhance or hinder expiration?

   5. What factors hinder elastic recoil? How does emphysema fit into this picture?

   4. Total collapse of the lung/alveoli (total atelectasis) normally does NOT occur. Why NOT?
      a. Low intrathoracic pressure even after expiration--explain
      b. Surfactant

   6. Infant Respiratory Distress Syndrome (IRDS)—was called Hyaline Membrane Disease (HMD)
      a. What is it?
      b. How do you prevent it?
      c. How do you treat it? What do you do to the mother before delivery and why?
      d. What do you do for the baby?
      e. Respiratory therapy—how do these fit into this picture and why?
         1) C-PAP
         2) PEEP

Revised Spring 2006
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G. Compliance
   1. Definition
   2. Does compliance help or hinder inspiration?
   3. Abnormal compliance
   4. What are some related disorders?

H. Pneumothorax
   1. Definition
   2. Implications
   3. Causes
      a. Wound
      b. Rupture of a bleb (congenital abnormality)
   4. Correction by chest tube

I. Modified Respiratory Movements (Table 23.1)—on your own.

J. Breathing disorders that result in inadequate ventilation—how does each one fit into the concepts we’ve just discussed? Are they obstructive or restrictive?
   1. Paralysis of respiratory muscles
   2. Polio
   3. Tuberculosis
   4. Bronchitis
   5. Bronchial asthma
   6. Emphysema
   7. Lung cancer