The Respiratory System
Chapter 13

Bania

NHS - SCIENCE
I. Functions of the Respiratory System

A. Distribution of air/diffusion of oxygen and carbon dioxide
   1. Between air and blood external respiration
   2. Between blood and cells – internal respiration
   3. Excretory organ – removes CO2 from blood – makes less alkaline

B. Movement of air into and out of the lungs - ventilation

C. Conditions air - warms, moistens, and cleans incoming air

D. Sound production

E. Detection of odors

F. RESPIRATION - Exchange of gases between the atmosphere, the blood, and the cells
II. Organs of the Respiratory System

A. Nose - warms, cleans and conditions air

B. sinuses - not pictured - resonates sound

C. pharynx - muscular junction of oral/nose passage

D. larynx - voice box - separates pipes (epiglottis)

E. trachea - wind pipe

F. LUNGS
   1. bronchi (bronchioles)
   2. Alveoli – grapes for gas exchange
III. Respiratory Tracts

A. Upper respiratory tract (URT)
   1. located outside the chest cavity
   2. nose, pharynx, larynx, and associated structures

B. lower respiratory tract (LRT)
   1. located within chest cavity
   2. trachea, bronchi, lungs
IV. Respiratory Mucosa

A. Membrane that lines most of the air distribution tubes in the system

B. covered with blanket of mucus

C. contains hair-like projections called cilia

D. Functions:

1. lines distribution tubes and lungs

2. cleanses, warms and humidifies the air
V. Nose

A. Passageway for air going into the lungs- air enters - external nares (nostrils)

B. Function:
   1. Warms – very vascular – heat leaves blood vessels and warms air
   2. Moistens – by water evaporating from the mucous lining
   3. filters air – mucous and cilia
Nose (Paranasal sinuses)

C. Four paranasal sinuses drain into the nasal cavities
   1. Maxillary
   2. Frontal
   3. Ethmoid
   4. Sphenoid

D. Reduce the weight of skull, clean air, and resonate sound

E. Sinus infections - sinusitis
VI. Pharynx
A. Commonly called the throat - 5 inches
B. nasopharynx - upper most tube behind nose
C. oropharynx - portion behind the mouth
D. laryngopharynx - lower portion
E. used in respiration and digestion
F. Connected to auditory tube - throat /ear infections
G. tonsils - lymphatic tissues - tonsillitis = infection; tonsillectomy
   1. pharyngeal tonsils (adenoids) - located in upper portion
   2. palatine tonsils - located in oropharynx
Larynx

- Voice Box - below the pharynx
- Composed of cartilage - largest - Adam’s apple
- Houses vocal cords on interior
- Glottis - space between vocal cords
- Epiglottis - cartilage trapdoor that covers the larynx - closes during swallowing
Trachea

- Windpipe - 11 cm long - made of noncollapsible material
- Connects air to lungs - lined by ciliated epithelia - produces mucous
Cilia

- Trap dust and foreign particles
- keep dust from reaching lungs
- sweep dust toward nostrils
- move only in one direction

- cigarette smoke paralyzes cilia, which causes accumulations of mucus

(smokers’ cough)
Bronchi, Bronchioles and Aveoli

- **Primary Bronchi** - first Branches
- **Secondary bronchi** - separation in each of the lungs
- **Bronchioles** - very small passageways
- **Alveolar ducts** - microscopic tubes "bunch of grapes" - made up of numerous alveoli
- **Alveoli** - gas exchange - in contact with capillaries - covered by surfactant - helps reduce surface tension
Lungs and Pleura

- The right side of the lung has 3 lobes and the left side has 2 lobes.
- Fits inside the ribs.
- Pleura - cover outside of lungs - thin, moist, slippery membrane; Pleurisy - inflammation of the pleura.
  - Visceral pleura - covers the lungs.
  - Partietaal pleura - lines the thoracic cavity.
  - Pneumothorax - air in interpleural space.

Diagram:
- Bronchioles
- Bronchi
- Trachea Rings of cartilage
- Pleural membrane
- Pleural cavity
- Diaphragm
Respiration

- Exchange of gases - organs provide a space for gas and blood to come in contact with each other
- Pulmonary ventilation (breathing) - moves air in and out of lungs
- Exchange of air between lungs and blood - external
- Exchange of air between blood and cells - internal respiration (cellular)
Mechanisms

- Inspiration - moves air into the lungs
- Expiration - moves air out of the lungs
- Hiccup - spontaneous spasm of the diaphragm
Inspiration

- Muscles of inspiration = diaphragm
- Flattening makes chest longer - air moves in
- Phrenic nerve stimulate diaphragm to contract
Expiration

- Normal expiration involves relaxation of the diaphragm.
- During forceful expiration, accessory expiration muscles are used (abdominal)
Sagittal View of Face and Neck

1. Sphenoid air sinus
2. Pharyngeal tonsil (adenoids)
3. Auditory tube
4. Soft palate
5. Uvula
6. Palatine tonsil
7. Lingual tonsil
8. Esophagus
9. Thyroid cartilage
10. Vocal cords
11. Epiglottis
12. Hyoid bone
13. Mandible
14. Tongue
15. Hard palate
16. Inferior concha
17. Middle concha
18. Nasal bone
19. Frontal air sinus
20. Superior concha
Exchange of gases

- Diffusion is the process in which gases exchange
- Oxygen combines with hemoglobin in RBC to form oxyhemoglobin
- Most carbon dioxide in blood as a bicarbonate or attached to RBC carbaminohemoglobin is also exchanges
- Internally - diffusion moves these gases to and from cells
Figure 16.20

Gases are exchanged between alveolar air and capillary blood because of differences in partial pressures.
Figure 16.21

(a) Oxygen molecules entering blood flow (from body tissues) and hemoglobin molecules. Net diffusion of oxygen.

(b) Blood $P_O_2 = 104$ mm Hg entering capillary. Hemoglobin molecules. Tissue cells $P_O_2 = 40$ mm Hg. Net diffusion of oxygen.
Figure 16.23
In the lungs, carbon dioxide diffuses from the plasma into alveoli.
Volume of air exchanged

 Spirometer - measure the amount of air used

 Air that comes and goes on a regular basis (like the tides) is known as a tidal volume

 Vital capacity - largest amount of air that can be taken in

 Expiratory reserve volume (ERV) - amount of air that can be forcefully exhaled

 Inspiratory reserve volume (IRV) - amount of air that can be forcefully inhaled

 Residual Volume - amount of air left over after forceful exhalation
Regulation of Respiration

- Normal 12 to 18 breathes a minute - more when we exercise
- Respiratory control center - located in medulla and pons of the brain
- Receptors sense oxygen and carbon dioxide
- Medulla has inspiratory control centers and expiratory control centers
Cerebral Cortex

- Influence respiration by influencing stimulating neurons
- Speed up/Slow down breathing rate
Receptors that Influence respiration

- Chemoreceptors - located in corotid and aortic arteries sense O₂, CO₂, blood acidity
- Pulmonary Stretch receptors - located through the pulmonary alveoli and airways - detects excess stretch