Chapter 22 The Respiratory System
Incomplete Outline

I. Anatomy of the Respiratory System
  A. Organs and Divisions
    1. Principle Organs: nose, pharynx, larynx, trachea, bronchi, and lungs
    2. _____ Division: from the nostrils through the major bronchioles
    3. Respiratory Division: the _____ and other gas-exchange regions
    4. Upper Respiratory Tract: from the nose to the _____
    5. Lower respiratory Tract: regions from the _____ through the lungs
  B. The Nose
    1. Functions:
      a. warms, cleanses and humidifies air
      b. detects _____
      c. _____ chamber that amplifies the voice
    2. Anatomy:
      a. Facial part of the nose is shaped by bone and _____ cartilage
      b. Nasal cavity: internal chamber of the nose divided into two halves...
        i Nasal _____: right and left halves of the nasal cavity
        ii Nasal _____: the dividing wall of the nasal cavity
      c. Vestibule: small dilated chamber just inside the nostril
        iii Bordered with _____ _____ that block insects and debris
      d. Nasal _____: three folds of tissue in the nasal cavity
        iv Superior, middle, and inferior
      e. _____: air passage found beneath each concha
      f. Respiratory epithelium: lines a majority of the respiratory system that has _____ to move mucus
  C. The Pharynx: tube from the conchae to the larynx (three regions)
    1. _____: receives the auditory tubes, houses the pharyngeal tonsil, inhaled air turns 90 degrees downward as it passes through
    2. Oropharynx: contains the _____ tonsils
    3. Laryngopharynx: passes only air and is lined by pseudostratified columnar epithelium
  D. The _____: voice box
    1. Function is to keep food and drink out of the airway
    2. _____: flap of tissue that guards the opening of the larynx
    3. Thyroid cartilage
      a. Laryngeal prominence: anterior peak known as the _____ _____ found in males
    4. Vestibular folds: close the larynx during swallowing
    5. _____ _____: produce sound when air passes between them
  E. The Trachea: windpipe anterior to the esophagus
    1. Supported by 16-20 C shaped rings of hyaline cartilage
    2. _____ _____: mechanism of debris removal
  F. Lungs and Bronchial Tree
    1. _____: two conical organs that rest on the diaphragm
    2. _____: through which the lungs receives the main bronchus, blood vessels, lymphatics, and nerves

3. Lobes: the right lung has _____ lobes and the left has _____
4. Bronchial Tree: branching system of air tubes
   a. Right main (_____) bronchus: arises from the fork of the trachea and is slightly wider and more vertical than the left resulting in more lodged objects
      v Gives of three branches called the lobar bronchi
   b. Left main bronchus: more narrow and _____ with only two lobar bronchi
   c. _____: continuations of the airway that lack supportive cartilage
   d. Path of Airflow: nasal cavity -> pharynx -> _____ -> main bronchus -> lobar bronchus -> segmental bronchus -> _____ -> terminal bronchiole -> respiratory bronchiole -> alveolar duct -> atrium -> alveolus
5. _____: sacs that serve as the site of gas exchange
   a. Squamous and cuboidal great alveolar cells and alveolar macrophages

G. The Pleurae
1. _____ pleura: surface of the lung that extends into the fissures
2. Parietal pleura: adheres to the _____, inner surface of the rib cage, and diaphragm
3. _____ cavity: space between the parietal and visceral pleurae
4. Pleural functions: reduce friction, create pressure gradient, and compartmentalize

II. Pulmonary Ventilation

A. Respiration Cycle: one complete inspiration and expiration
1. _____ respiration: breathing at rest
2. _____ respiration: deep or rapid breathing

B. Respiratory Muscles
1. _____: prime mover of respiration
   a. When relaxed, the lungs are at their _____ volume
   b. When contracted, the lungs are at their _____ volume
2. Internal and external intercostal muscles: _____ of the diaphragm found between the ribs

C. Neural Control of Breathing
1. Brainstem Respiratory Centers: automatic, unconscious cycle of breathing
   a. _____ respiratory group: primary generator of the respiratory rhythm
      vi Inspiratory and expiratory neurons: two webs of neurons found in the _____ that form a reverberating circuit
      vii Output from the spinal centers travel by way of the _____ and _____ nerves
   b. _____ respiratory group: receives input from several sources and issues output to the VRG that modifies the respiratory rhythm
   c. _____ respiratory group: receives input from higher brain centers and adapt breathing to sleep, exercise, vocalization, and emotional responses
2. Voluntary Control of Breathing: originates in the _____ _____
   a. There are limits to voluntary control, automatic controls override one's will

D. Pressure, Resistance, and Airflow
1. Pressure and Airflow
   a. _____ pressure: the weight of the air above us
   b. _____ pressure: pressure from the lungs
   c. Boyle's Law: the pressure of a given quantity of gas is _____ proportional to its volume

viii If the intrapulmonary pressure drops _____ than the atmospheric pressure surrounding the body, then air tends to flow _____ its pressure gradient into the lungs. Conversely, if intrapulmonary pressure _____ above atmospheric pressure, air flows out of the lungs.

2. Inspiration: during inspiration, the lungs expand and as they increase in _____ the internal pressure _____ and air flows in
3. Expiration: a passive process that compresses the lungs as the diaphragm raises up and _____ the intrapulmonary pressure, thus expelling air
4. Resistance to Airflow
   a. Diameter of bronchioles
      ix _____: the more constricted the diameter, the less air that is able to pass through
      x _____: the more widened the diameter, the more air that is able to pass through
   b. Pulmonary _____: the ease with which the lungs expand
   c. Surface tension of the alveoli and distal bronchioles
      xi _____: an agent that disrupts the hydrogen bonds water and reduces surface tension
         - Premature infants often have a deficiency of pulmonary surfactant and experience great difficulty breathing

III. Gas Exchange and Transport

A. _____ Gas Exchange: back-and-forth traffic of O2 loading and CO2 unloading across the respiratory membrane
   1. The reason that O2 can diffuse in one direction and CO2 in the other is that each gas diffuses down its own pressure gradient
   2. Both O2 loading and CO2 unloading involve RBCs, the efficiency of these processes therefore depends on how long an RBC spends in an alveolar capillary

B. _____ Gas Exchange: the unloading of O2 and loading of CO2 at the systemic capillaries

C. Blood Gases and the Respiratory Rhythm: the most potent stimulus for breathing is ____, followed by CO2, and lastly ____
   1. Hydrogen Ions
      a. _____: a blood pH lower than 7.35
      b. _____: a blood pH greater than 7.45
      c. The PCO2 of arterial blood normally ranges from 37 to 43mmHg
         xii Hypocapnia: PCO2 less than 37mmHg
         xiii Hypercapnia: PCO2 greater than 43mmHg
      d. Carbonic acid levels determine the levels of ____
         xiv As CO2 levels increase, carbonic acid levels increase thus _____ the pH
            - Aka respiratory _____
            - Corrective response: _____ to release more CO2
         xv As CO2 levels decrease, carbonic acid levels decrease thus _____ the pH
            - Aka respiratory _____
            - Corrective response: _____ or breathing into a bag to retain more CO2
   2. _____ _____: has an indirect effect on pH
   3. _____: usually has little effect on respiration
      a. A moderate drop in PO2 does stimulate the peripheral chemoreceptors

xvi Long term _____: drives respiration more than CO2 or pH
xvii Also occurs in situations such as emphysema, pneumonia, and mountain climbing

IV. Respiratory Disorders
- A. Oxygen Imbalances
  1. Hypoxia: a deficiency of oxygen in a tissue
     - a. Hypoxemic hypoxia: inadequate _____ gas exchange
     - b. Ischemic hypoxia: inadequate _____ of the blood
     - c. Anemic hypoxia: due to anemia (inability of the blood to carry adequate oxygen)
     - d. _____ hypoxia: poison
     - e. Cyanosis: symptom of hypoxia resulting in _____ of the skin

     xviii Primary effect is _____
  2. Oxygen toxicity: when _____ oxygen is breathed
     - a. Generates _____ _____ and free radicals that destroy enzymes and nervous tissue

     xix Thus leading to seizures, coma and death
- B. Chronic Obstructive Pulmonary Diseases: long-term obstruction of airflow
  1. Major COPDs: asthma, _____, and chronic bronchitis
     - a. Chronic bronchitis: _____ are immobilized, while _____ cells enlarge and produce excess mucus
     - b. _____: lungs become fibrotic and less elastic

     xx Lungs tend to collapse and obstruct during _____
     - c. COPD tends to cause hypoxemia, hypercapnia, respiratory acidosis, and cardiomegaly