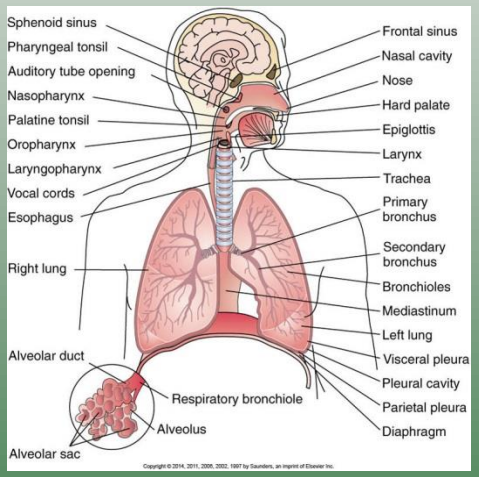
Chapter 13

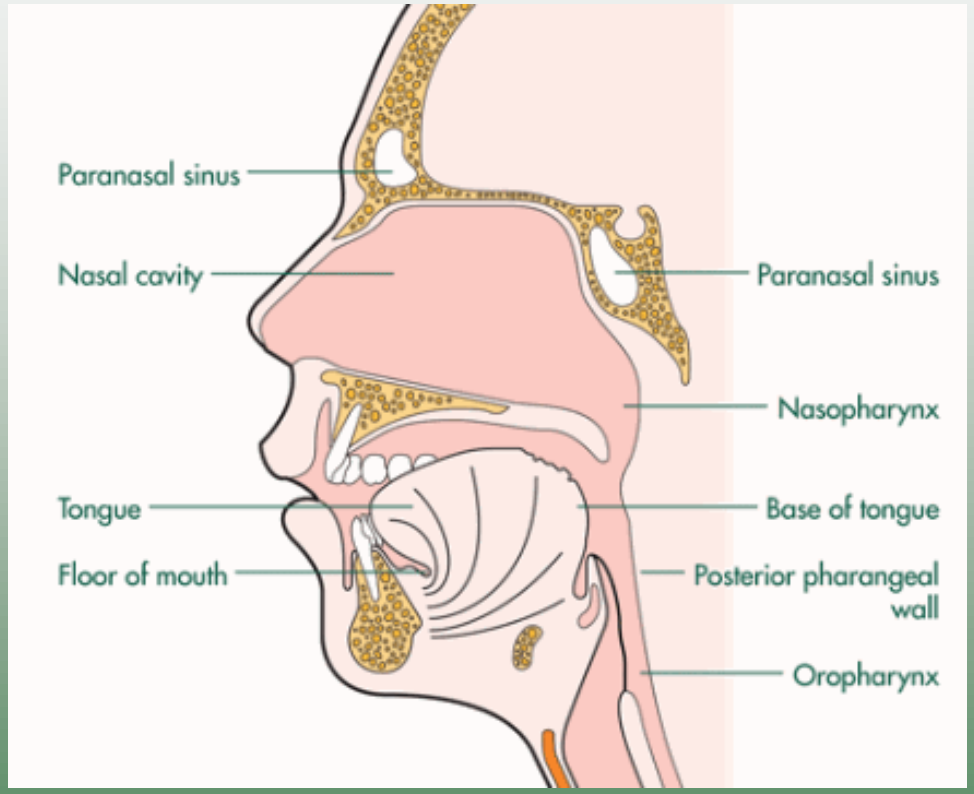
Respiratory System Disorders

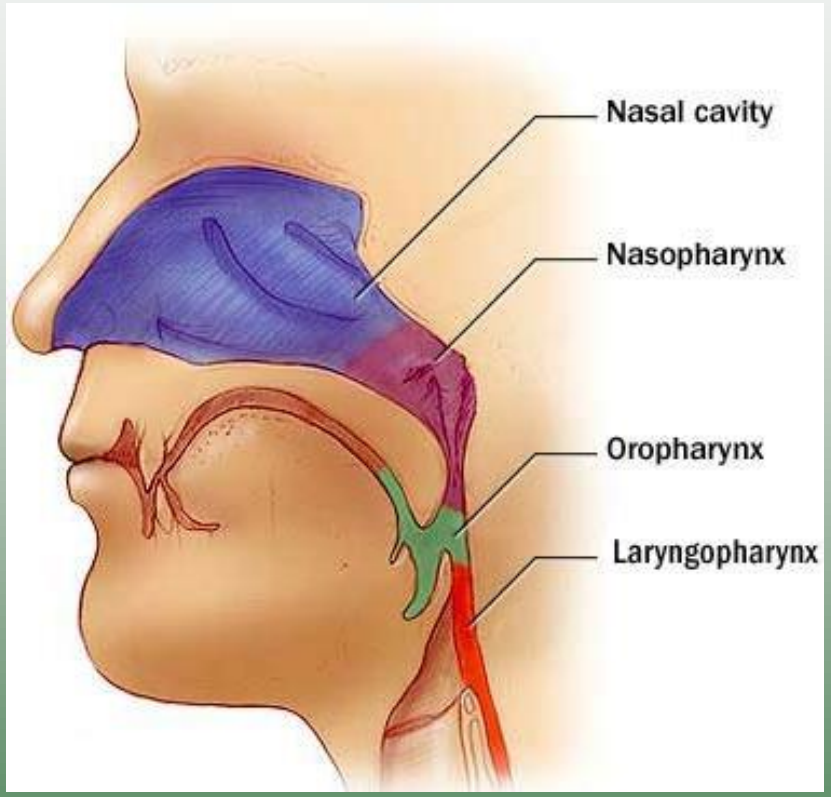


Respiratory System: Purpose and General Function

- Transport of oxygen from air to blood
- Removal of carbon dioxide from the blood
- Two anatomical areas
  - Upper respiratory tract
    - Resident flora
  - Lower respiratory tract
    - Sterile

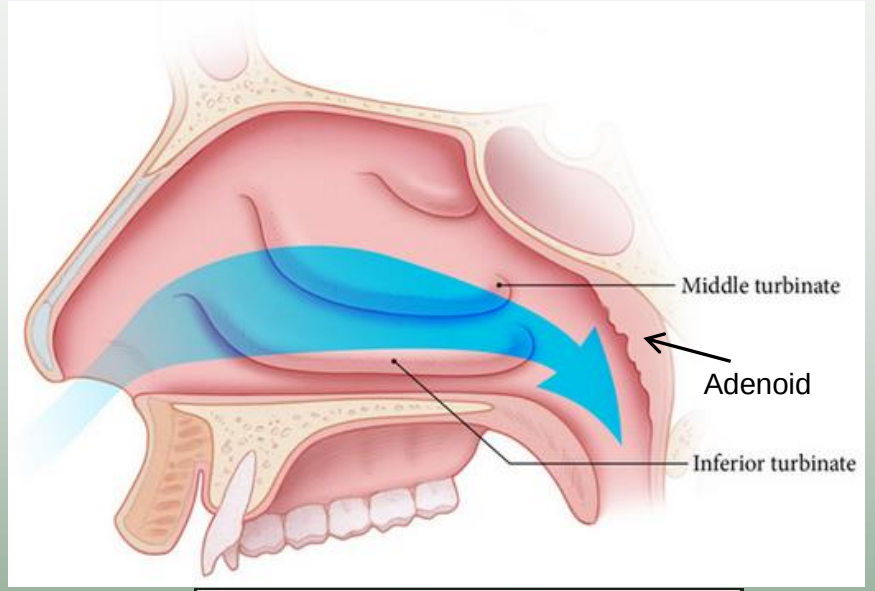
Upper Respiratory Tract

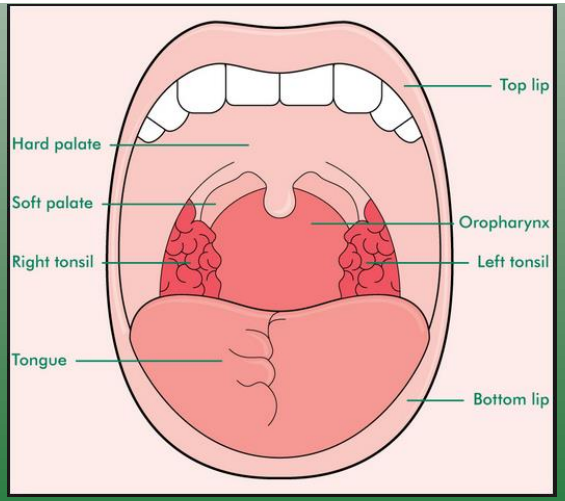




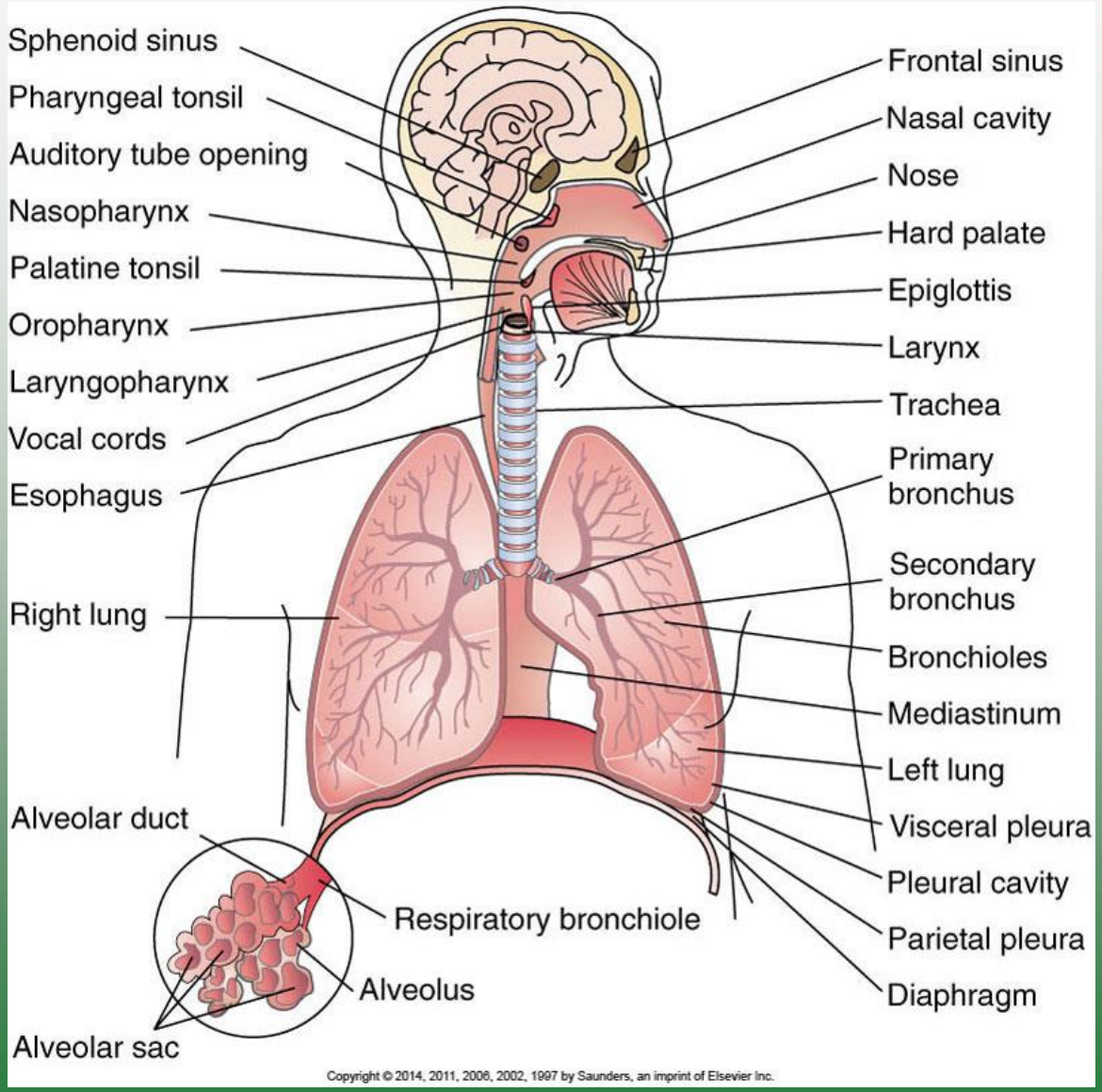
Upper Respiratory Tract

- Nasal cavity
  - Warming and moistening of air
  - Foreign material trapped by mucous secretions
- Nasopharynx
  - Pharyngeal tonsils in posterior wall
- Palatine tonsils
  - Lymphoid tissue in posterior portion of the oral cavity





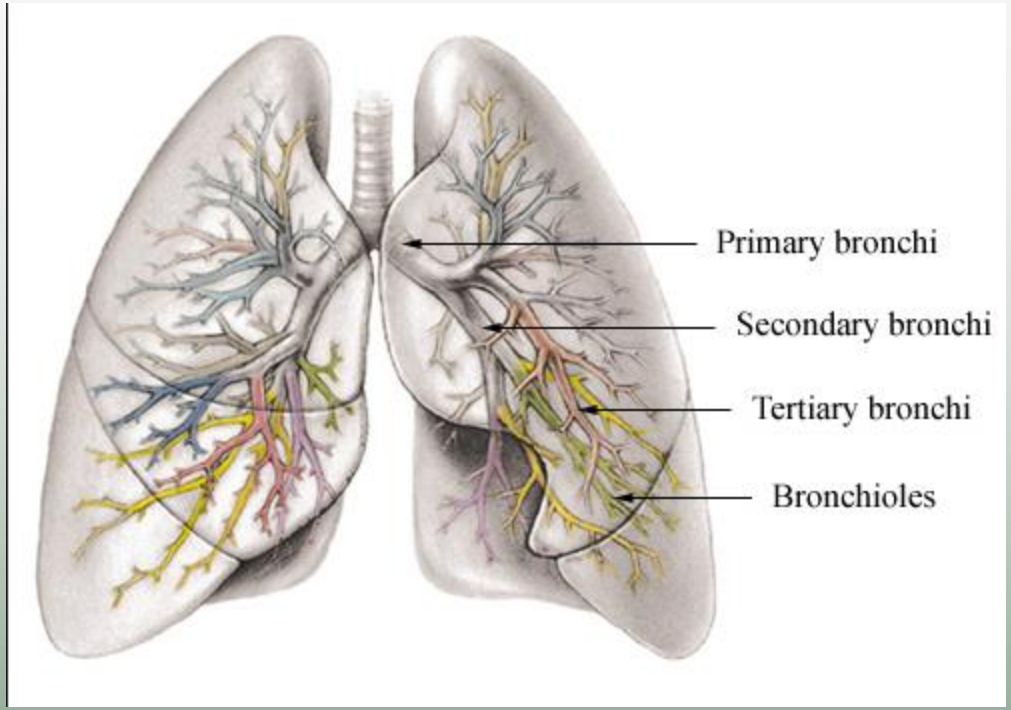
Anatomy of the Respiratory System

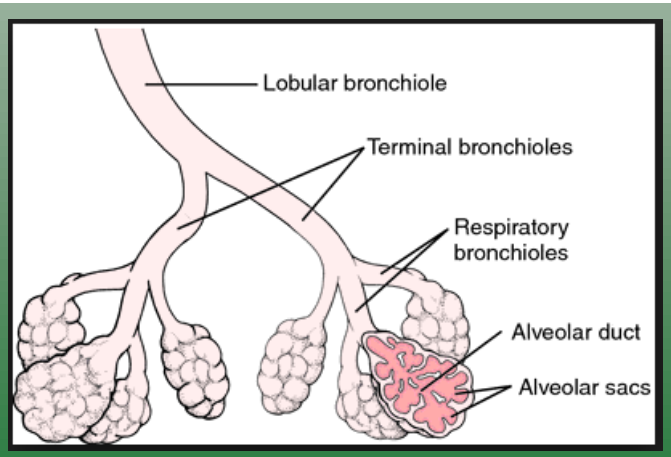


Lower Respiratory Tract

Trachea branches into:

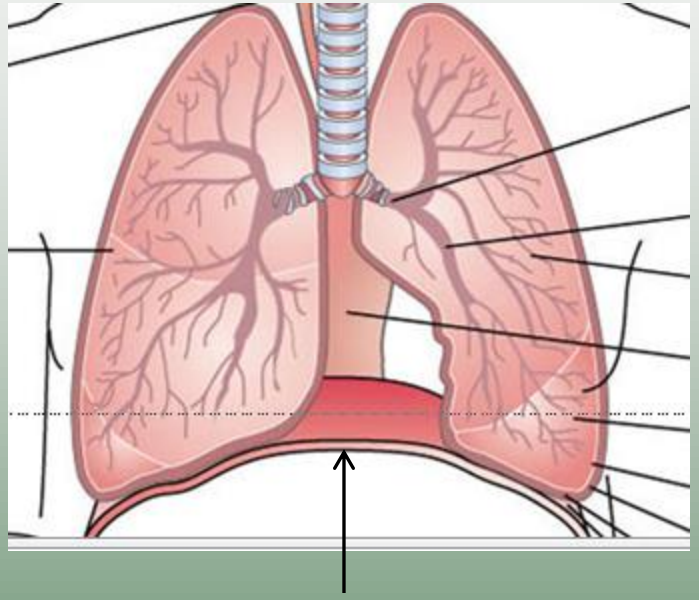
- Right and left primary bronchi
- Secondary bronchi
- Bronchioles
- Terminal bronchioles
- Respiratory bronchioles
- Alveolar ducts
- Alveoli—lined by simple squamous epithelium and surfactant to reduce surface tension and maintain inflation
  - ➤ End point for inspired air
  - ➤ Site of gas exchange





Ventilation

- Process of inspiration and expiration
  - Airflow depends on pressure gradient (Boyle's law).
    - Air always moves from high-pressure area to low- pressure area
  - Inspiration creates low pressure in lungs and air moves into lungs
  - Expiration creates high pressure in lungs and air moves out of lungs



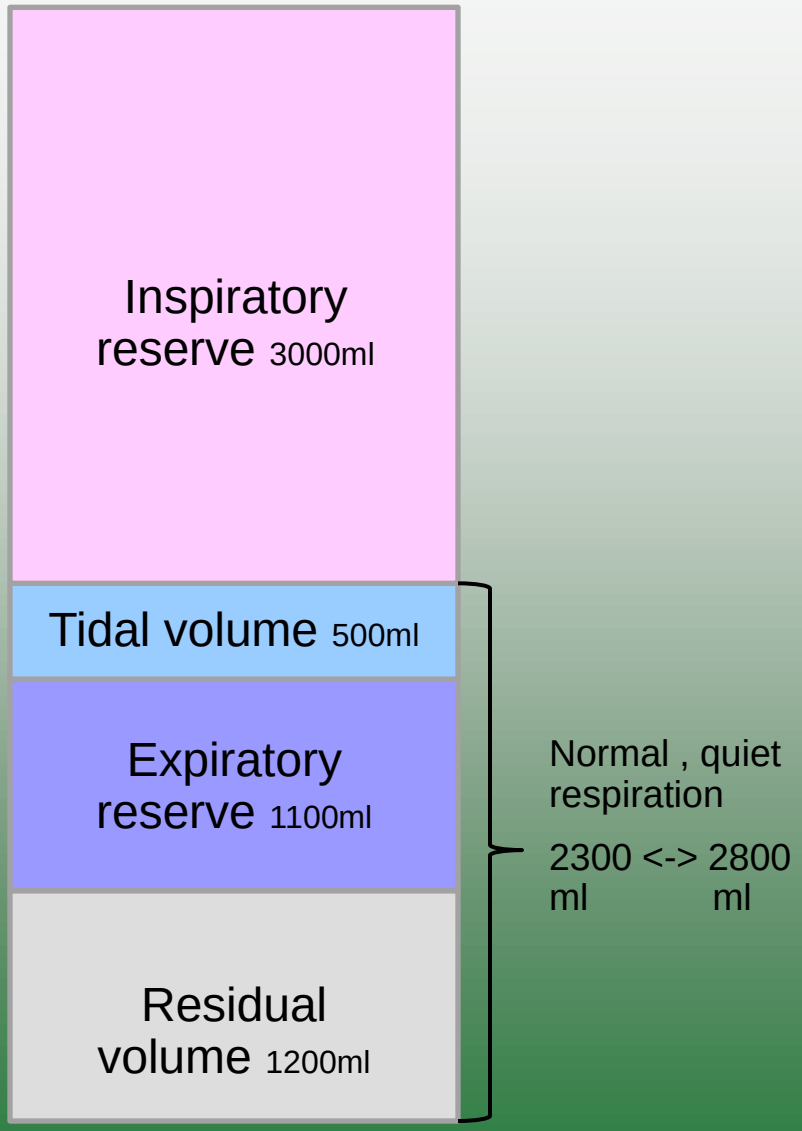
Pulmonary Volumes

- **Tidal volume** is the amount of air exchanged with quiet inspiration and expiration.
- **Vital capacity**
  - Maximal amount of air that can be moved in and out of the lungs with a single forced inspiration and expiration
- **Residual volume**
  - Volume of air remaining in lungs after maximum expiration

Pulmonary Volumes

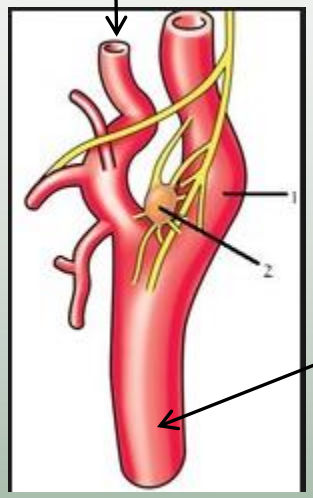
TABLE 13-1 Pulmonary Volumes

Name	Volume	Meaning
Tidal volume (TV)	500 mL	Amount of air entering lungs with each normal breath
Residual volume (RV)	1200 mL	Amount of air remaining in the lungs after forced expiration
Inspiratory reserve (IRV)	3000 mL	Maximal amount of air that can be inhaled in excess of normal quiet inspiration
Expiratory reserve (ERV)	1100 mL	Maximal volume of air expired following a passive expiration
Vital capacity (VC)	4600 mL	Maximal amount of air expired following a maximal inspiration
Total lung capacity (TLC)	5800 mL	Total volume of air in the lungs after maximal inspiration



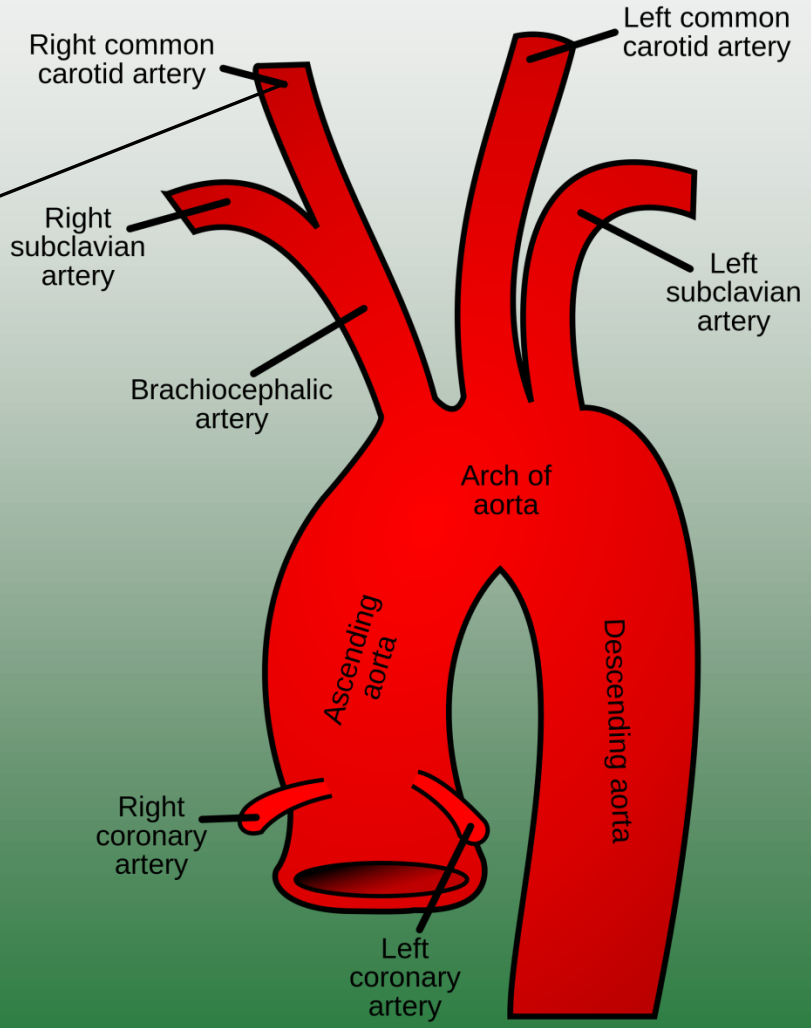
Review of Great Vessels

External and Internal Carotids



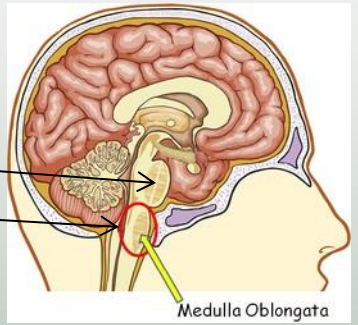
1- Carotid Sinus

2 – Carotid body

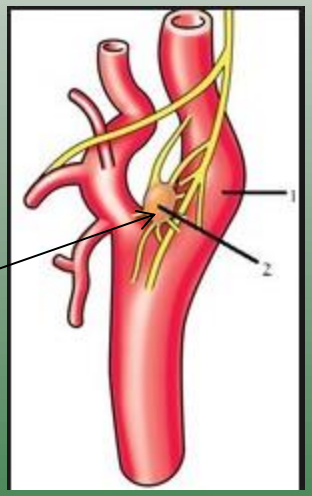


Control of Ventilation

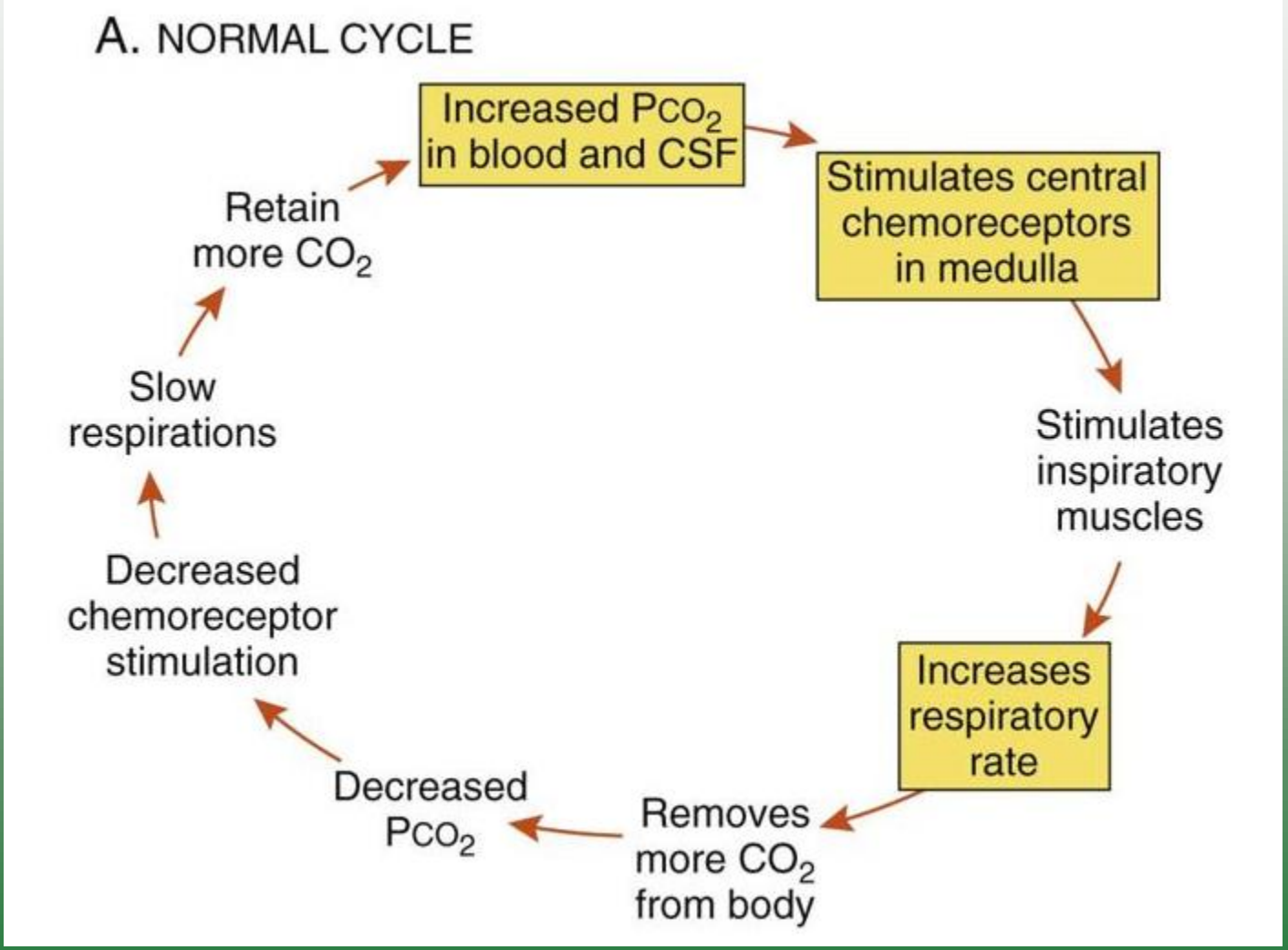
- Primary control centers for breathing
  - Located in the medulla and pons



- Chemoreceptors detect changes in carbon dioxide level, hydrogen ion, and oxygen levels in blood or cerebrospinal fluid (CSF)
  - Central chemoreceptors
    - Located in the medulla
  - Peripheral chemoreceptors
    - Located in the carotid bodies



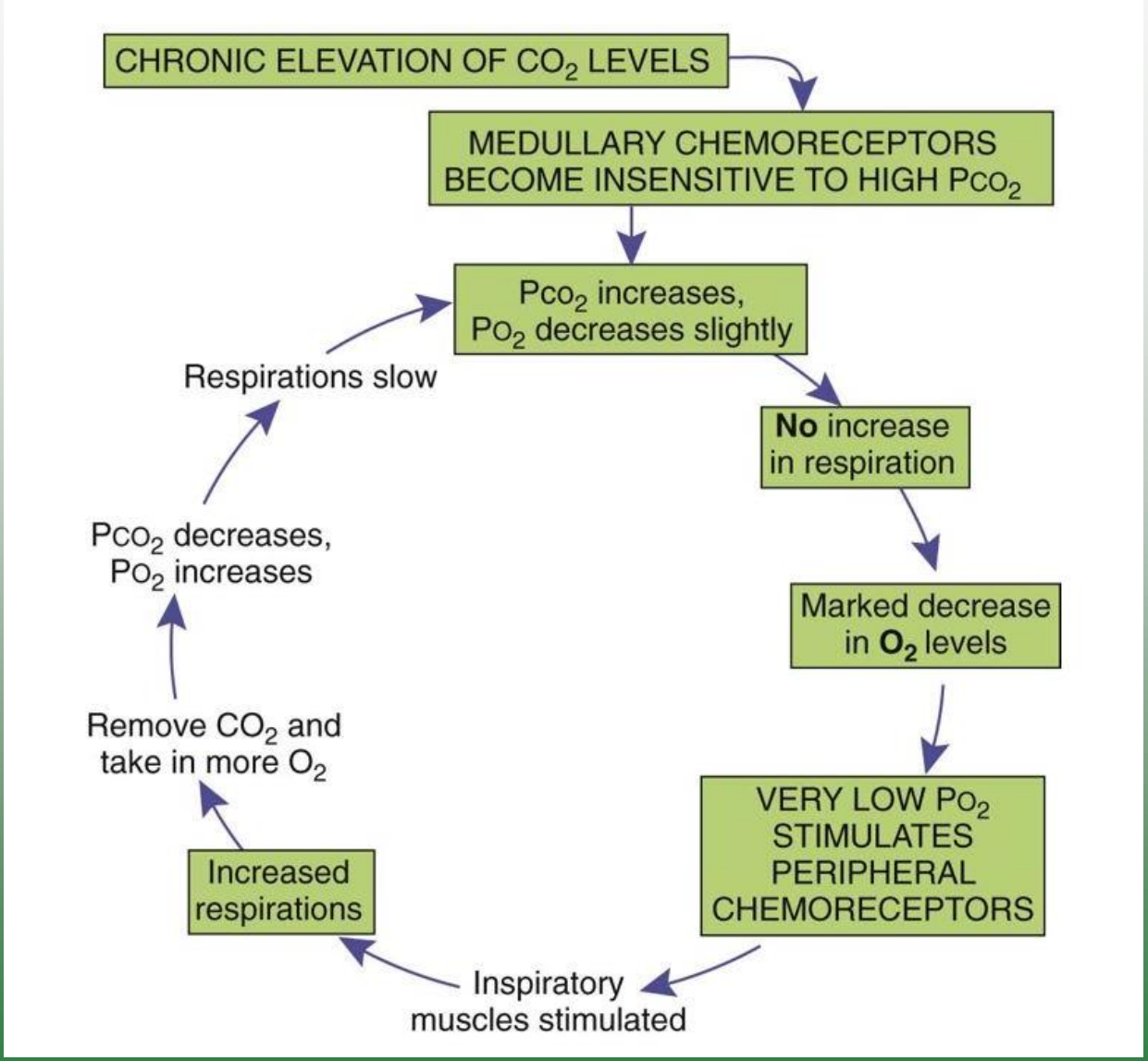
Respiratory Control



Control of Ventilation (Cont.)

- Hypercapnia
  - Carbon dioxide elevated in the blood.
  - Carbon dioxide easily diffuses into CSF.
    - Lowers pH and stimulates respiratory center
    - Increased rate and depth of respirations (hyperventilation) to blow off CO_2
- Hypoxemia
  - Oxygen decreased in blood.
    - Chemoreceptors respond but oxygen must be low
    - Usually high CO_2 drives respiration before low O_2.

Hypoxic Drive

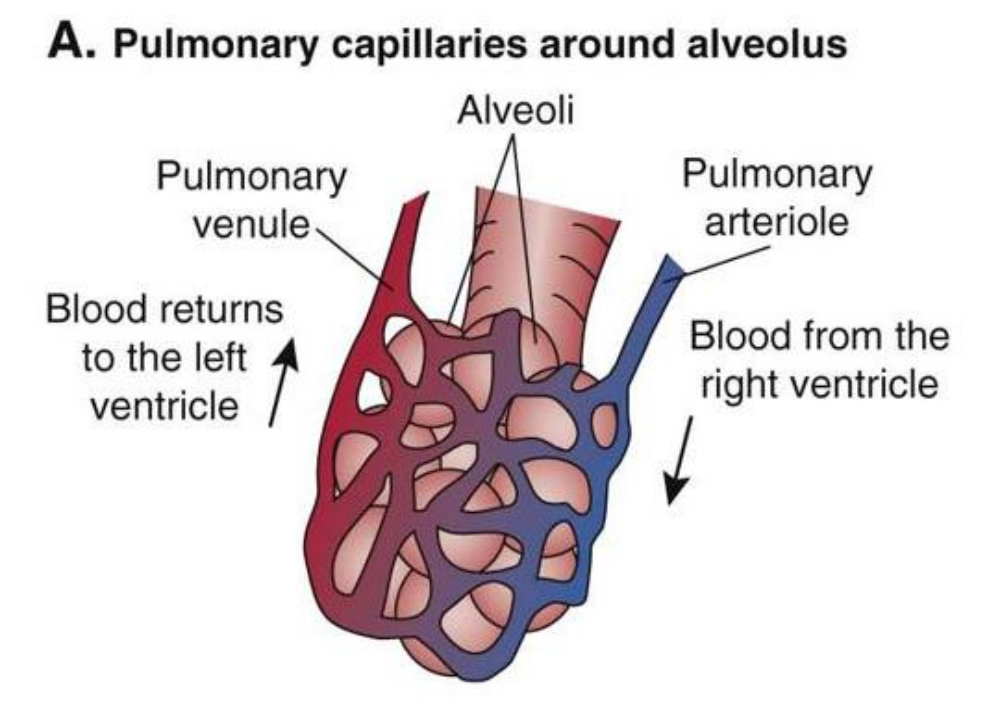


Control of Ventilation (Cont.)

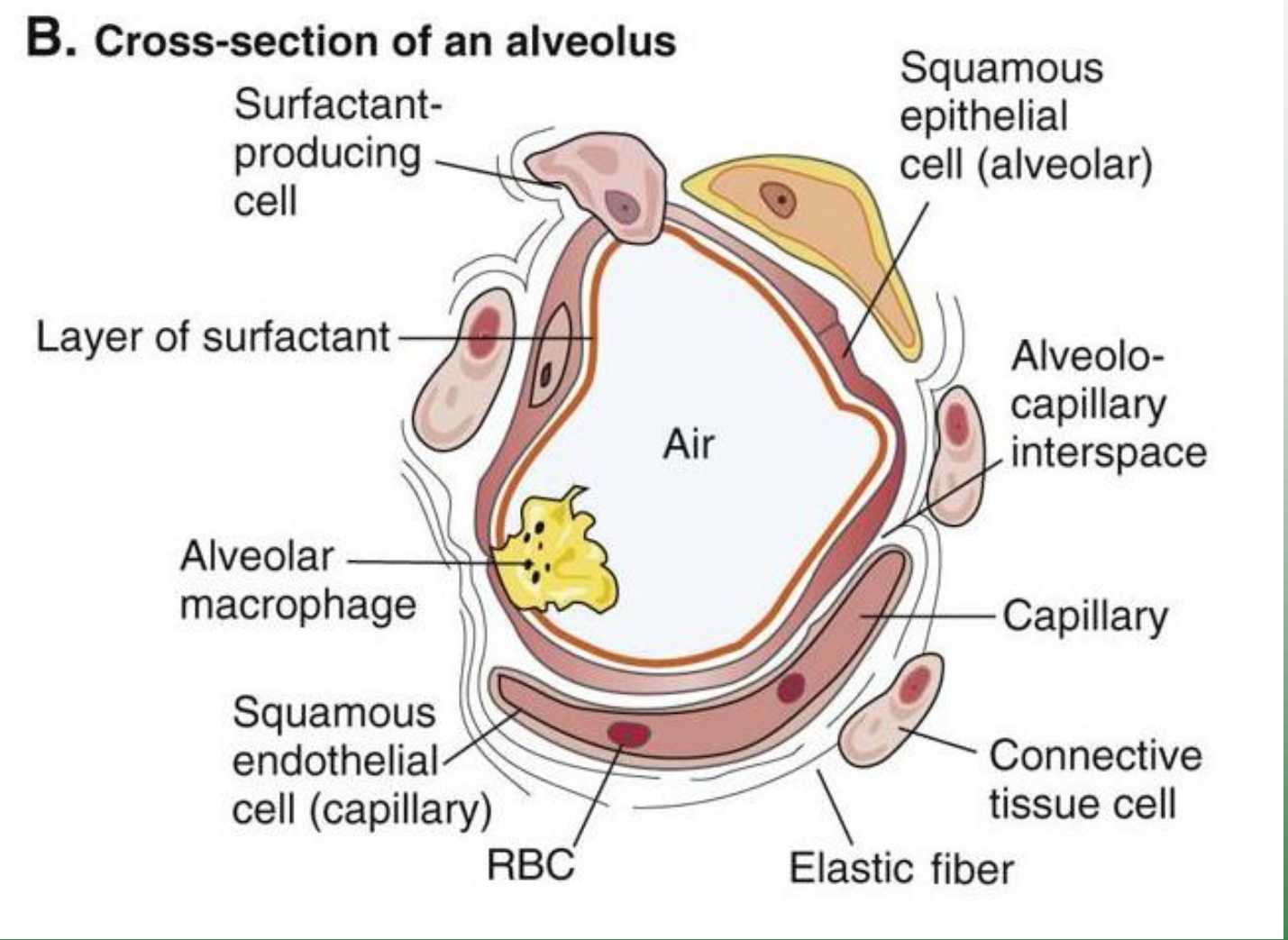
- Hypocapnia
  - Low carbon dioxide concentration in blood
    - May be caused by hyperventilation
      - Excessive amounts of carbon dioxide expired

Gas Exchange

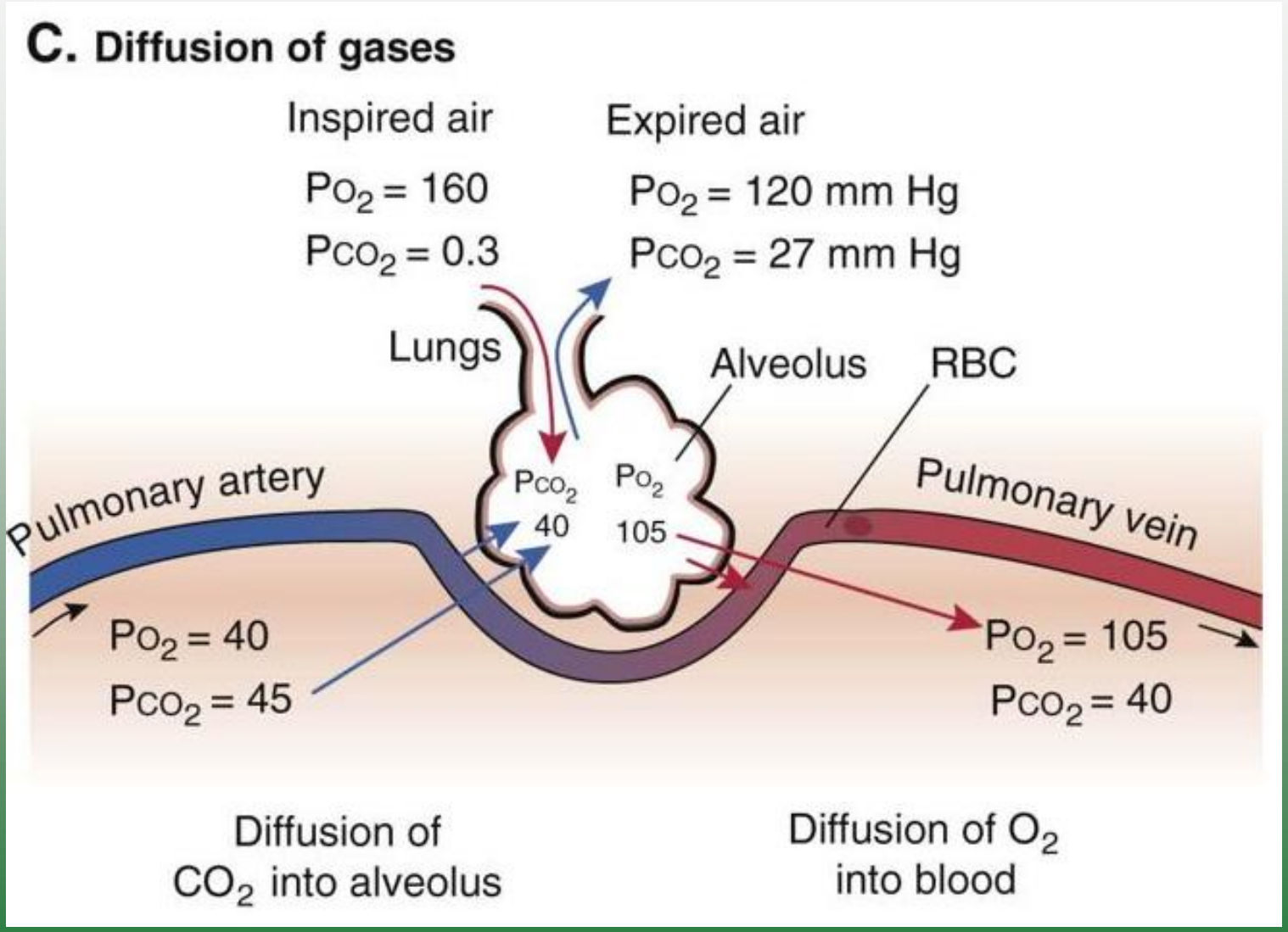
- Gas exchange depends on the relative concentrations (partial pressures) of the gases.
  - P_{O_2}—partial pressure of oxygen
  - P_{CO_2}—partial pressure of carbon dioxide
- Each gas in a mixture moves along its partial pressure gradient, independent of other gases (Dalton's law).



Cross Section of Alveolus



Diffusion of Gases



Factors Affecting Diffusion of Gases

- Partial pressure gradient
- Thickness of the respiratory membrane
  - Fluid accumulation in alveoli or interstitial tissue impairs gas exchange.
- Total surface area available for diffusion
  - If part of alveolar wall is destroyed, surface area is reduced, so less exchange
- Ventilation-perfusion ratio
  - Ventilation (air flow) and perfusion (blood flow) need to match for maximum gas exchange.

Diagnostic Tests

- Spirometry—pulmonary function test (PFT)
  - Test pulmonary volumes and airflow times
- Arterial blood gas determination
  - Checks oxygen, carbon dioxide, bicarbonate, serum pH
- Oximetry
  - Measures O_2 saturation
- Exercise tolerance testing
  - For patients with chronic pulmonary disease

Diagnostic Tests (Cont.)

- Radiography
  - Helpful in evaluating tumors
  - Evaluate infections
- Bronchoscopy
  - Perform biopsy.
  - Check site of lesion or bleeding.
- Culture and sensitivity tests
  - Sputum testing for presence of pathogens
  - Determine antimicrobial sensitivity of pathogen

General Manifestations of Respiratory Disease

- Sneezing
  - Reflex response to irritation in upper respiratory tract
    - Assists in removing irritant
    - Associated with inflammation or foreign material
- Coughing
  - Irritation caused by nasal discharge
  - Inflammation or foreign material in lower respiratory tract
  - Caused by inhaled irritants

General Manifestations of Respiratory Disease

- Sputum
  - **Yellowish-green**, cloudy, thick mucus
    - Often indication of a bacterial infection
  - **Rusty or dark**-colored sputum
    - Usually sign of pneumococcal pneumonia
  - Very large amounts of purulent sputum with **foul odor**
    - May be associated with bronchiectasis
  - Thick, **tenacious** mucus
    - Asthma or cystic fibrosis, blood-tinged sputum—may result from chronic cough; may also be sign of tumor or tuberculosis
  - Hemoptysis
    - **Blood-tinged** (bright red) frothy sputum, usually associated with pulmonary edema

General Manifestations of Respiratory Disease (Cont.)

- Breathing patterns and characteristics (Cont.)
  - Labored respiration or prolonged inspiration or expiration
    - Often associated with obstruction of airways
  - Wheezing or whistling sounds
    - Indicate obstruction in small airways
  - Stridor
    - High-pitched crowing noise
    - Usually indicates upper airway obstruction

General Manifestations of Respiratory Disease (Cont.)

- Breath sounds (heard with Stethoscope)
  - Rales
    - Light bubbly or crackling sounds, with serous secretions
  - Rhonchi
    - Deeper or harsher sounds from thicker mucus
  - Absence
    - Nonaeration or collapse of lungs

Respiratory Patterns

Pattern		Description
Eupnea		Rhythm is smooth and even with expiration longer than inspiration.
Tachypnea		Rapid superficial breathing; regular or irregular rhythm.
Bradypnea		Slow respiratory rate; deeper than usual depth; regular rhythm.
Apnea		Cessation of breathing.
Hyperpnea		Increased depth of respiration with a normal to increased rate and regular rhythm.
Cheyne-Stokes respiration		Periodic breathing associated with periods of apnea, alternating regularly with a series of respiratory cycles; the respiratory cycle gradually increases, then decreases in rate and depth.
Ataxic breathing		Periods of apnea alternating irregularly with a series of shallow breaths of equal depth.
Kussmaul's respiration		Deep regular sighing respirations with an increase in respiratory rate.
Apneusis		Long, gasping inspiratory phase followed by a short, inadequate expiratory phase.
Obstructed breathing		Long, ineffective expiratory phase with shallow, increased respirations.

General Manifestations of Respiratory Disease

- Dyspnea
  - Difficult breathing
    - May be caused by increased carbon dioxide or hypoxemia
    - Often noted on exertion, such as climbing stairs
- Severe dyspnea - respiratory distress
  - Flaring of nostrils
  - Use of accessory respiratory muscles
  - Retraction of muscles between or above ribs
- Orthopnea
  - Dyspnea when lying down
  - Usually caused by pulmonary congestion

General Manifestations of Respiratory Disease

- Paroxysmal nocturnal dyspnea
  - Sudden acute dyspnea at night
  - Common in patients with left-sided congestive heart failure
- Cyanosis
  - ➢ Bluish coloring of skin and mucous membranes
    - Caused by large amounts of unoxygenated hemoglobin in blood
- Pleural pain
  - ➢ Results from inflammation or infection of parietal pleura

General Manifestations of Respiratory Disease

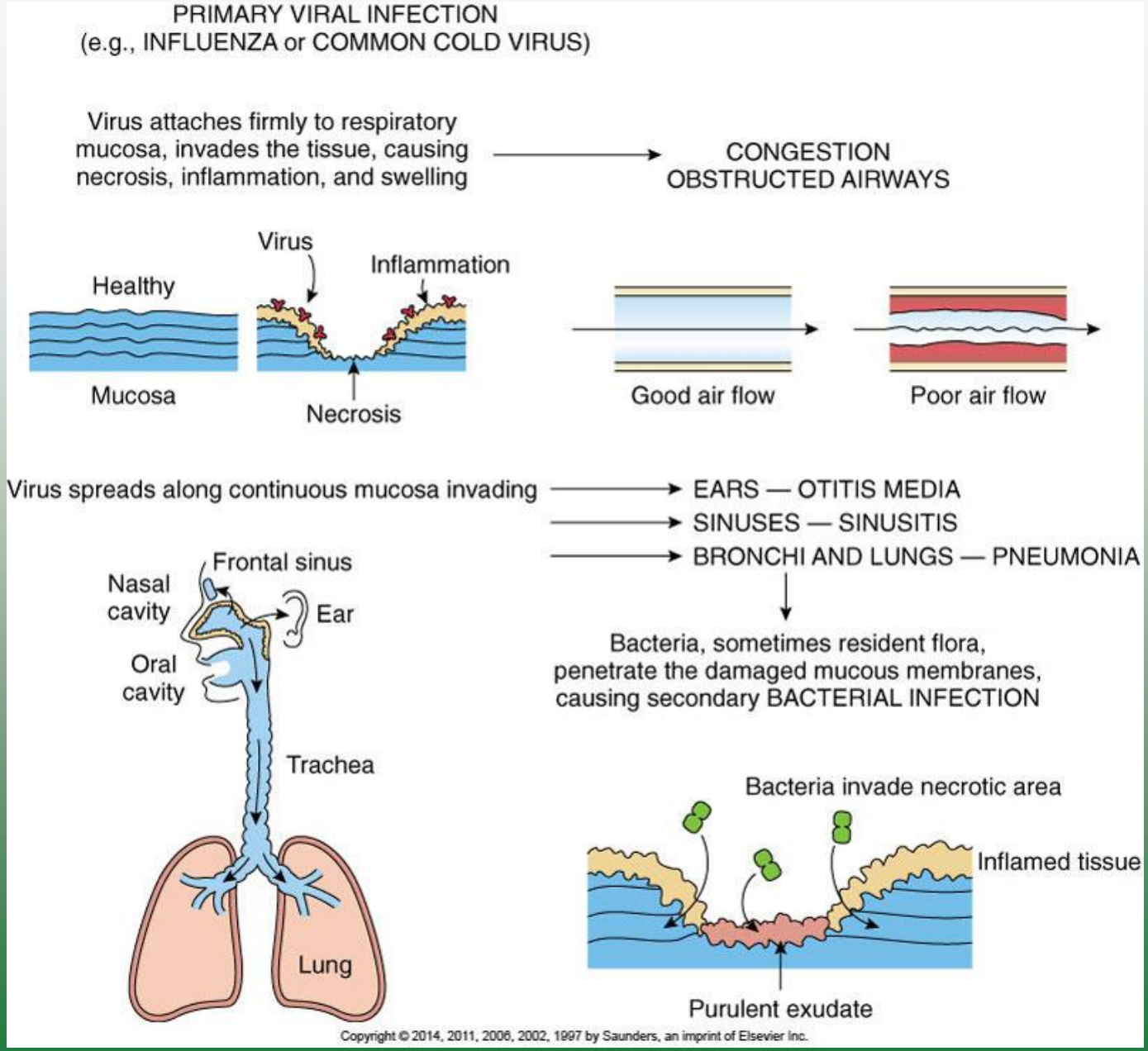
- Friction rub
  - Soft sound produced as rough, inflamed, or scarred pleural move against each other
- Clubbed digits
  - Result from chronic hypoxia associated with respiratory or cardiovascular diseases
    - Painless, firm, fibrotic enlargement at the end of the digit

Infectious Diseases

Upper Respiratory Tract Infections

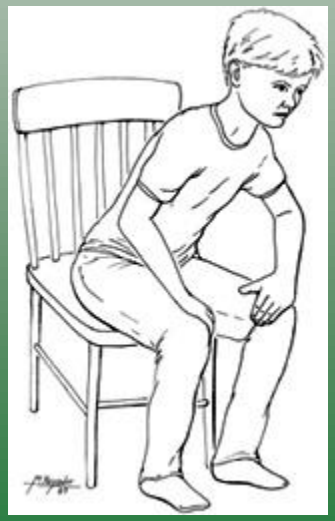
- Common cold (infectious rhinitis)
  - Viral infection
  - More than 200 possible causative agents
  - Spread through respiratory droplets
  - Hand-washing and respiratory hygiene important in prevention
  - Symptomatic treatment
  - Secondary bacterial infections may occur.
    - Usually caused by streptococci
    - Purulent exudate; systemic signs, such as fever

Complications of Viral Respiratory Infection



Upper Respiratory Tract Infections

- Sinusitis
  - Usually bacterial infection
- Laryngotracheobronchitis (croup)
  - Common viral infection, particularly in children
  - Common causative organism
    - **Parainfluenza viruses and adenoviruses**
  - Infection usually self-limited
- Epiglottitis
  - Acute infection common in children ages 3 to 7 years
  - Usually caused by *Haemophilus influenzae* type B
  - Rapid onset; fever and sore throat
  - Child sits in tripod position
  - Drooling and difficulty swallowing
  - Heightened anxiety
  - Danger of significant obstruction from spasm if touched



Upper Respiratory Tract Infections: Influenza (Flu)

- Viral infection
- Three groups of influenza viruses
  - Type A (most prevalent), types B and C
  - Type A includes H1N1
- Sudden, acute onset with fever, marked fatigue, aching pain in the body
  - May also cause viral pneumonia
  - Mild case of influenza may be complicated by secondary bacterial pneumonia.
  - Commonly, deaths in flu epidemics result from pneumonia.

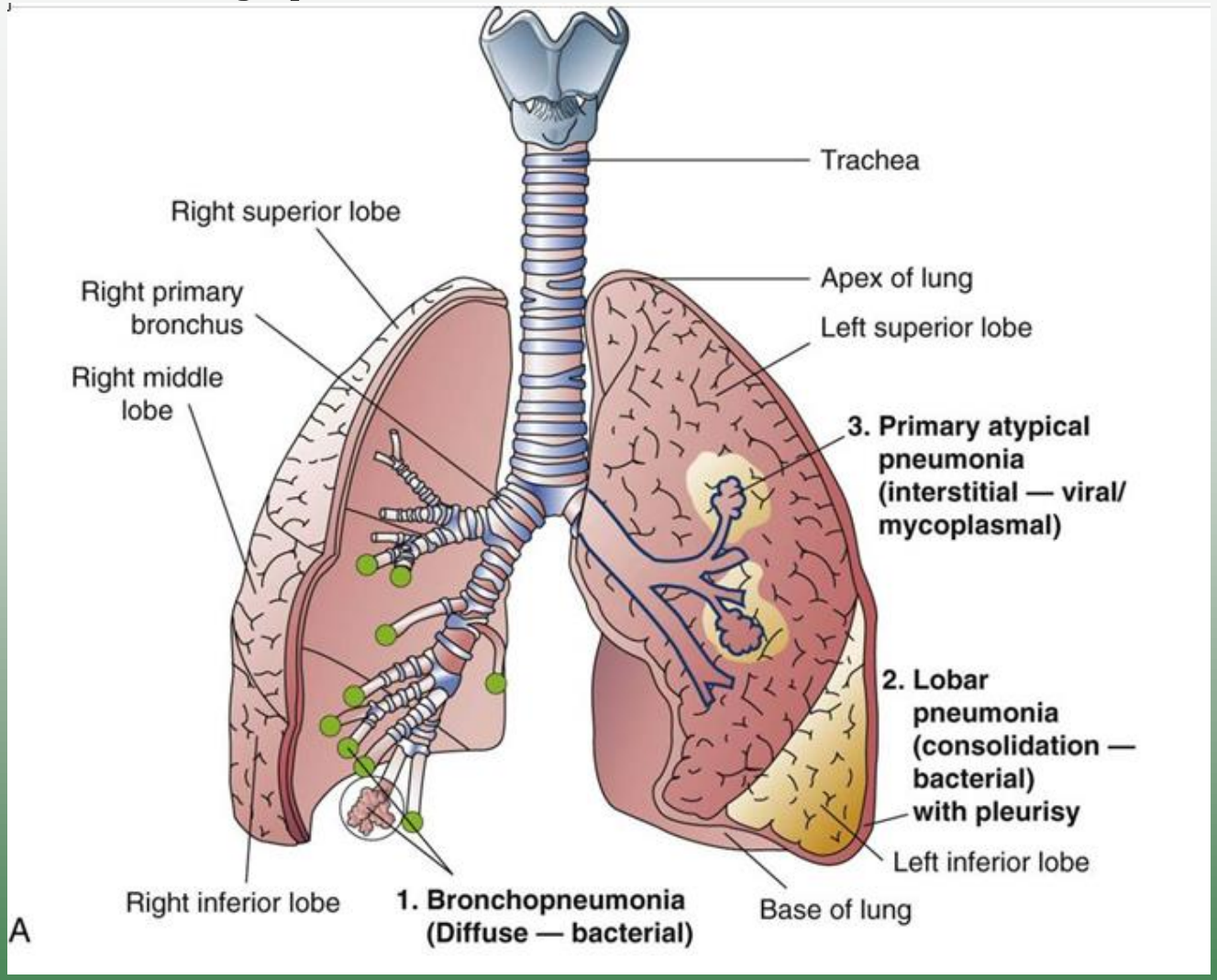
Scarlet Fever

- Caused by group A β-hemolytic *Streptococcus* (*S. pyogenes*)
- Symptoms
  - Typical “strawberry” tongue
  - Fever, sore throat
  - Chills, vomiting, abdominal pain, malaise

Lower Respiratory Tract Infections: **Bronchiolitis**

- Caused by the respiratory syncytial virus **(RSV)**
- Transmitted by oral droplet
- Virus causes necrosis, inflammation in small bronchi and bronchioles
- Signs
  - Wheezing and dyspnea, rapid shallow respirations, cough, rales, chest retractions, fever, malaise
- Treatment
  - Supportive and symptomatic

Types of Pneumonia



Infection may spread to pleural cavity—empyema

Bronchopneumonia Lobar Pneumonia

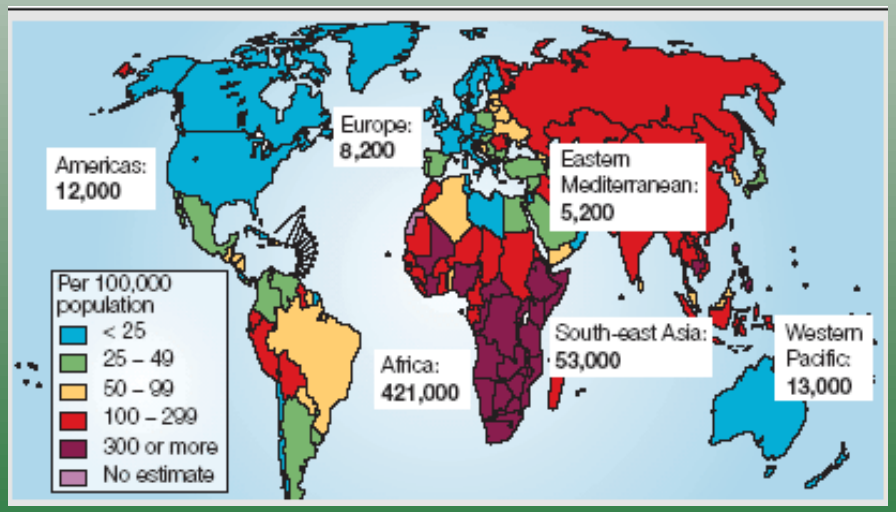
- Legionnaires' Disease
  - Caused by *Legionella pneumophila*
  - Thrives in warm, moist environments
  - Often nosocomial infection
  - Difficult to identify—requires special culture
  - Possibly fatal
- Primary Atypical Pneumonia
  - *Mycoplasma pneumoniae*—bacterial
  - Common in older children and young adults
  - Infection varies greatly in severity.
  - Infection is usually self-limiting.

Severe Acute Respiratory Syndrome (SARS)

- Acute respiratory infection
- Causative microbe: **SARS-associated coronavirus**
  - Transmission by respiratory droplets—close contact (travelers).
  - First signs
    - Fever, headache, myalgia, chills, anorexia, possibly diarrhea
  - Later signs
    - Effect on lungs evident—dry cough, marked dyspnea; areas of interstitial congestion, hypoxia; mechanical ventilation may be required.
  - High fatality rate
  - Risk factors (monitored to prevent outbreaks)
    - Travel to endemic or epidemic area
    - Close contact with such a traveler

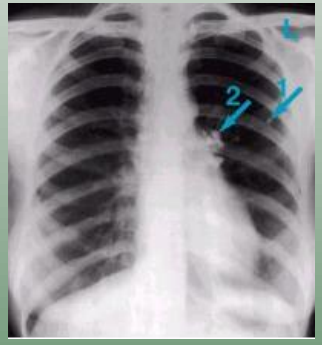
Tuberculosis

- Cause
  - *Mycobacterium tuberculosis* transmitted by oral droplets from persons with active infection
  - Occurs more frequently with:
    - People living in crowded conditions
    - Immunodeficiency
    - Malnutrition
    - Alcoholism
    - Conditions of war
    - Chronic disease
    - HIV infection



Tuberculosis

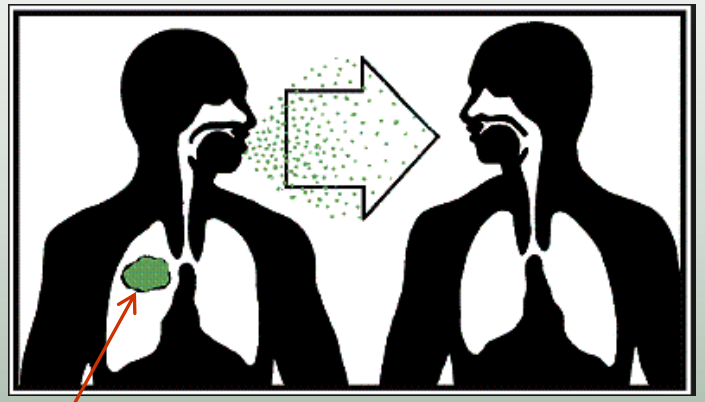
- Usual caused by *Mycobacterium tuberculosis*
  - Normal neutrophil response does not occur
  - Cell-mediated immunity normally protection
  - Primarily affects lungs; other organs may also be invaded
- Primary infection
  - When organism first enters the lungs



- Engulfed by macrophages—local inflammation
- If cell-mediated immunity is inadequate:
  - Mycobacteria reproduce and begin to destroy lung tissue.
- This form of disease is contagious!
- If cell-mediated immunity is adequate:
- Some bacilli migrate to lymph nodes—granuloma froms, calcifying
- Bacilli may remain viable in a dormant stage for years.
- Individual's resistance and immune responses high, bacilli remain walled off
- Primary or latent infection—individual has been exposed and infected, but does not have disease and is asymptomatic
- Individual cannot transmit disease

Tuberculosis (Cont.)

- Secondary or re-infection with TB
  - Occurs when client's cell-mediated immunity is impaired because of:
    - Stress
    - Malnutrition
    - HIV infection
    - Age
  - Mycobacteria begin to reproduce and infect lung.
  - Often seen as apical cavitation
  - Active TB, which can be spread to others!



Tuberculosis (Cont.)

- Miliary or **extrapulmonary tuberculosis**
  - Rapidly progressive form more common in children < 5 years
    - Early dissemination to other tissues
    - If **lesions are not found in the lungs, this is not contagious**.
    - Common symptoms include weight loss, failure to thrive, and other infections such as measles.

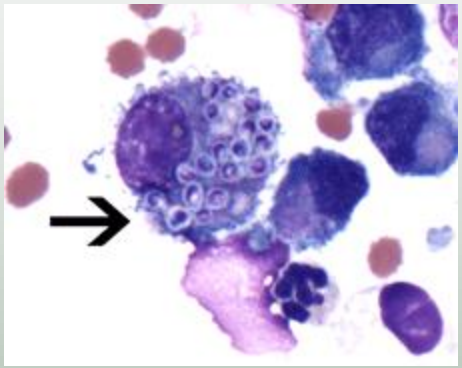
Tuberculosis (Cont.)

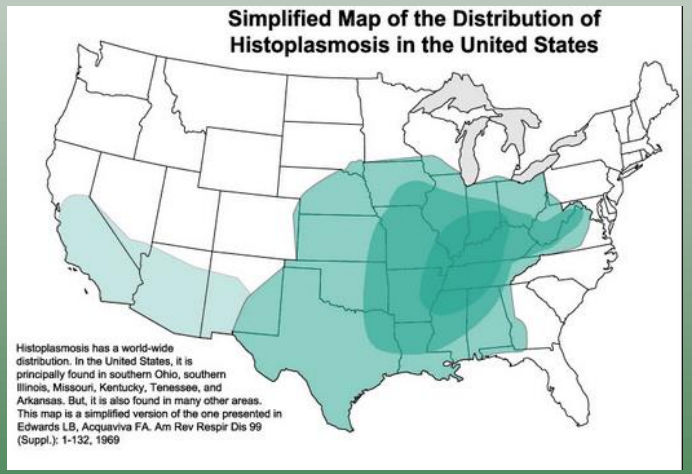
- Diagnostic tests
  - First exposure or primary infection
    - Indicated by positive tuberculin (skin) test results
    - Blood test – Quantiferon.
  - Active infections
    - Acid-fast sputum test
    - Chest radiograph
    - Sputum culture and sensitivity

- Treatment
  - Long-term treatment with a combination of drugs
  - Length of treatment varies from 6 to 12 months.

Histoplasmosis

- Fungal infection
  - *Histoplasma capsulatum*
    - Spores can be inhaled on dust particles.
- Common opportunistic infection
- First stage often asymptomatic
- Second stage
  - Granuloma formation and necrosis
  - Cough, fatigue, fever, night sweats
- Treatment—antifungal agents





Midwest, Calcified Lymph Nodes on Chest X-Ray

Anthrax

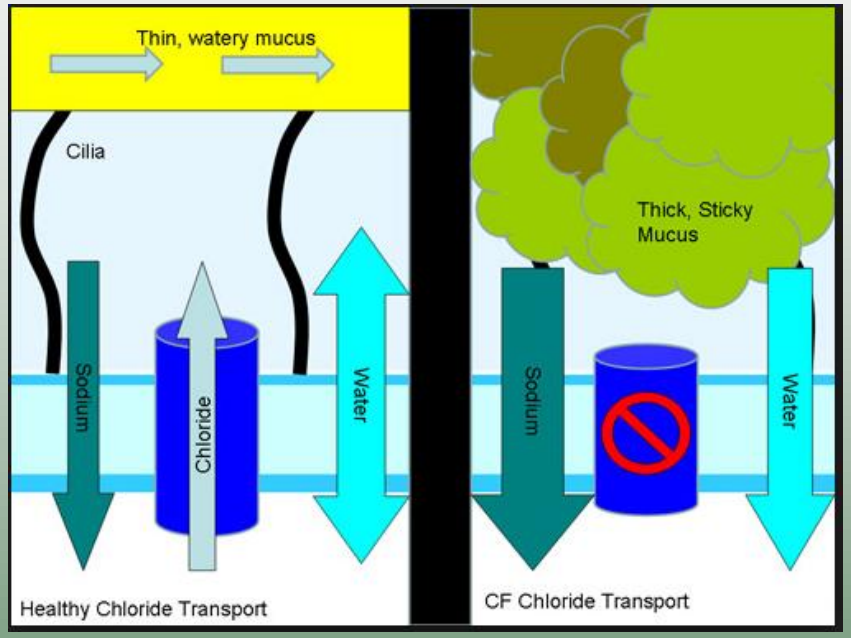
- Bacterial infection by gram-positive bacilli
- Inhalation anthrax
  - Flulike symptoms
  - Severe acute respiratory distress
  - Shock caused by release of toxins
  - High fatality rates
  -

END OF PART ONE

Obstructive Lung Diseases

Cystic Fibrosis

- Inherited (genetic) disorder
  - Gene located on chromosome 7
  - cystic fibrosis transmembrane conductance regulator (CFTR)
- Tenacious mucus from exocrine glands
- Primary effects seen in lungs and pancreas
- Lungs
  - Mucus obstructs airflow in bronchioles and small bronchi.
  - Permanent damage to bronchial walls
  - Infections are common.
    - Commonly caused by
    - *Pseudomonas aeruginosa* and *Staphylococcus aureus*



In sweat glands, the opposite occurs resulting in high levels of salt in the sweat

Cystic Fibrosis (Cont.)

- Digestive tract
  - Meconium ileus in newborns (mucoid stood impaction).
  - Blockage of pancreatic ducts (and pancreatic juice that contains lipase to digest fat) – leads to fatty stool – *steatorrhea*.
  - Obstruction of bile ducts (and bile that helps digest fat).
  - Salivary glands often mildly affected

- Reproductive tract (infertility).
  - Obstruction of vas deferens (male), blocks sperm transport from testes to semen.
  - Obstruction of cervix (female), thick mucus blocks sperm entrance into uterus.

- Sweat glands
  - Sweat has high sodium chloride content.

Cystic Fibrosis (Cont.)

- Diagnosis
  - Sweat chloride test (entry level test).
  - Genetic testing (definitive mutation analysis of CFTR)
  - Testing of stool, fat content and pancreatic trypsin level
  - Radiography, pulmonary function tests
  - Blood gas analysis
- Treatment
  - Interdisciplinary approach
    - Replacement therapy and well-balanced diet
      - High protein, low fat, and vitamin
      - Pancreatic enzymes and bile salts.
    - Chest physiotherapy
      - Including postural drainage, percussion, and coughing.

Lung Cancer

- **About 90% of cases are related to smoking.**
- Bronchogenic carcinoma
  - **Most common type of primary malignant lung tumor**
  - Dysplasia > Carcinoma in situ > Cancer
- Squamous cell carcinoma
  - Often central and may grow into airway.
- Adenocarcinomas (from glands)
- Bronchoalveolar cell carcinomas
  - Usually found on periphery of lung, less symtomatic.

Bronchiogenic Carcinoma

Lung Cancer (Cont.)

- Lung tumor effects
  - Obstruction of airflow into a bronchus
    - Causes abnormal breath sounds and dyspnea
  - Inflammation and bleeding surrounding the tumor
    - Cough, hemoptysis, and secondary infections
  - Pleural effusion, hemothorax, pneumothorax
  - Paraneoplastic syndrome
    - Occurs wen tumor cell secretes hormones or hormone-like substances
  - Usual systemic effects of cancer

Lung Cancer (Cont.)

- Systemic signs
  - Weight loss, anemia, fatigue
- Signs of metastases
  - Bone pain
  - Cognitive deficits, motor deficits

Lung Cancer (Cont.)

- Diagnostic tests
  - Specialized helical CT scans and MRI
  - Chest radiography
  - Bronchoscopy
  - Biopsy and mediastinoscopy
  -
- Treatment
  - Surgical resection or lobectomy
  - Chemotherapy and radiation
  - Photodynamic therapy

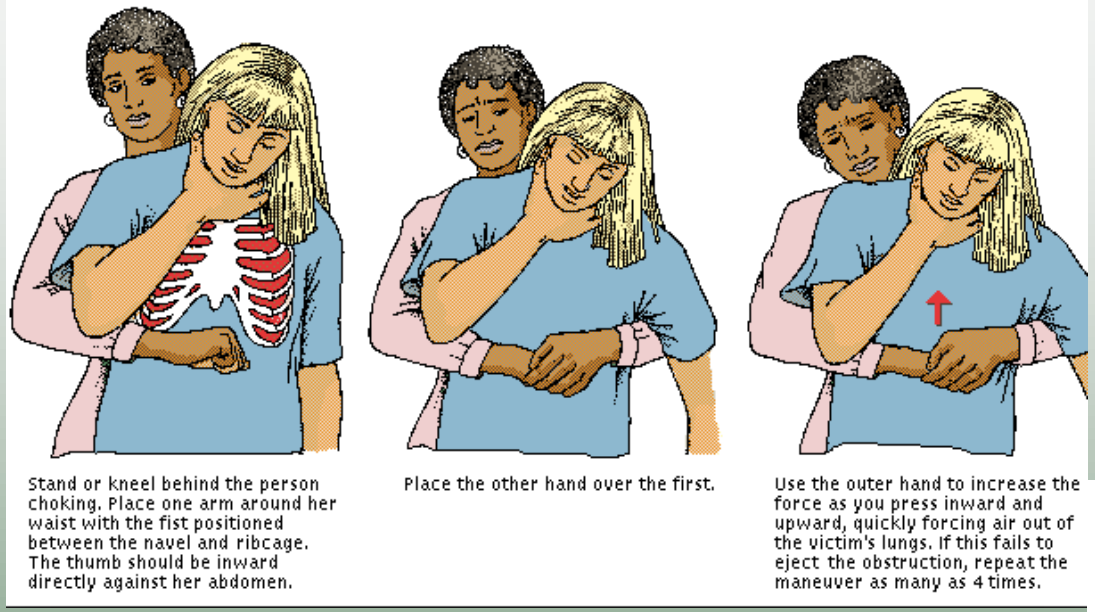
Aspiration

- Passage of food, fluid, emesis, other foreign material into trachea and lungs
- Common problem in young children or individuals laying down when eating or drinking
- A complication of a diminished gag reflex (post anesthesia, sedating drugs, CNS damage-stroke).
- Result may be:
  - Obstruction
    - Aspirate is a solid object.
  - Inflammation and swelling
    - Aspirate is an irritating liquid.
  - Predisposition to pneumonia

Aspiration (Cont.)

- Potential complications
  - Aspiration pneumonia
    - Inflammation—gas diffusion is impaired.
  - Respiratory distress syndrome
    - May develop if inflammation is widespread
  - Pulmonary abscess
    - May develop if microbes are in aspirate
  - Systemic effects
    - If aspirated materials (solvents) are absorbed into blood
  - Death if massive aspiration

Emergency Treatment for Aspiration



The Heimlich maneuver to dislodge the solid object is recommended (stand behind the victim with encircling arms, position a fist, thumb side against the abdomen, below the sternum, place the other hand over the fist and thrust forcefully inward and upward).

A foreign object may be ejected from an infant by back blows administered between the infant's shoulder blades, while the infant's body is supported over an arm or leg, head lower than the trunk

Obstructive Sleep Apnea

- Result of pharyngeal tissue collapse during sleep
  - Leads to repeated and momentary cessation of breathing
  - Men are affected more often than women.
  - Obesity and aging are common predisposing factors.
- Treatment
  - Continuous positive airway pressure pump (CPAP machine)
  - Oral appliances that reduce collapse of pharyngeal tissue

Asthma

- Bronchial obstruction
  - Occurs in persons with hypersensitive or hyperresponsive airways
- May occur in childhood or have an adult onset
- Often family history of allergic conditions

Asthma (Cont.)

- Extrinsic asthma
  - Acute episodes triggered by type I hypersensitivity reactions
- Intrinsic asthma
  - Onset during adulthood
  - Hyperresponsive tissue in airway initiates attack.
  - Stimuli include:
    - Respiratory infections
    - Stress
    - Exposure to cold
    - Inhalation of irritants
    - Exercise
    - Drugs

Asthma (Cont.)

- Pathophysiological changes of bronchi and bronchioles
  - Inflammation of the mucosa with edema
  - Bronchoconstriction
    - Caused by contraction of smooth muscle
  - Increased secretion of thick mucus
    - In airways
- Changes create obstructed airways, partial or total.

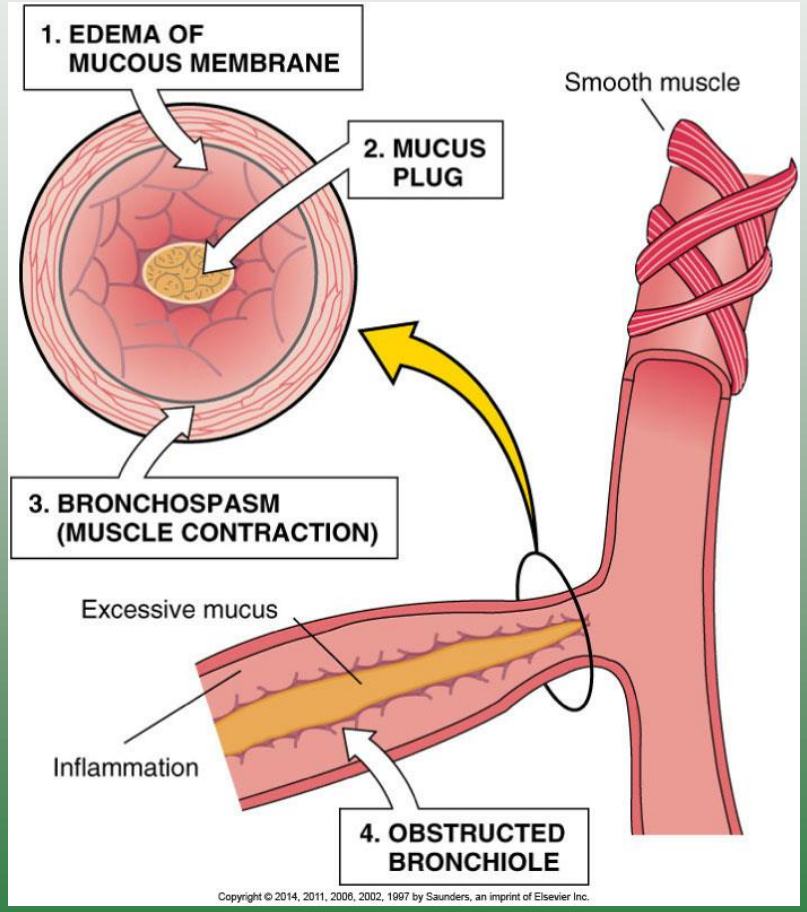
Asthma: Signs and Symptoms

- Cough, marked dyspnea, tight feeling in chest
- Wheezing
- Rapid and labored breathing
- Expulsion of thick or sticky mucus
- Tachycardia
  - Might include pulsus paradoxus
    - Pulse differs on inspiration and expiration
- Hypoxia

Asthma: Signs and Symptoms (Cont.)

- Respiratory alkalosis
  - Initially caused by hyperventilation
- Respiratory acidosis
  - Caused by air trapping
- Severe respiratory distress
  - Hypoventilation leads to hypoxemia and respiratory acidosis.
- Respiratory failure
  - Indicated by decreasing responsiveness, cyanosis

Asthma: Acute Episode



Asthma: Acute Episode (Cont.)

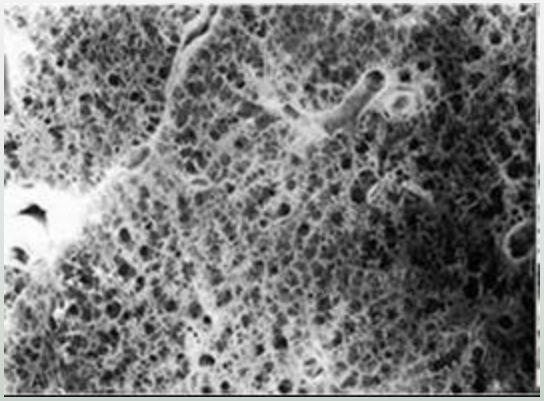
- Status asthmaticus
  - Persistent severe attack of asthma
    - Does not respond to usual therapy
    - Medical emergency!
    - May be fatal because of severe hypoxia and acidosis

Chronic Obstructive Pulmonary Disease (COPD)

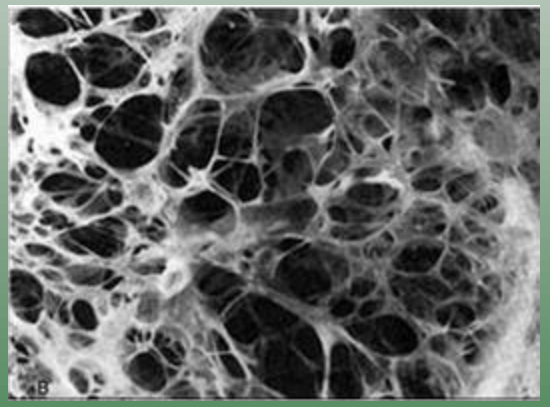
- Group of chronic respiratory disorders
- Causes irreversible and progressive damage to lungs including scarring. Compromises expiration.
- Debilitating conditions that may affect individual's ability to work
- Examples include emphysema, chronic bronchitis, and chronic asthma

Emphysema

- Progressive difficulty with expiration
  - Air trapping and increased residual volume
  - Overinflation of the lungs
  - Fixation of ribs in an respiratory position, increased anterior-posterior diameter of thorax (barrel chest)
  - Flattened diaphragm (on radiographs)
  - Hypercapnia becomes marked.
  - Hypoxia becomes driving force of respiration



Normal Lung



Emphysema

Chronic Bronchitis

- Inflammation, obstruction, repeated infection, chronic coughing twice for 3 months or longer in 2 years
  - History of cigarette smoking or living in urban or industrial area
  - Mucosa inflamed and swollen
  - Hypertrophy and hyperplasia of mucous glands
  - Fibrosis and thickening of bronchial wall
  - Low oxygen levels
  - Severe dyspnea and fatigue
  - Pulmonary hypertension and cor pulmonale (right ventricular hypertrophy).

Chronic Bronchitis (Cont.)

- Treatment
  - Cessation of smoking and reduction of exposure to irritants
  - Treatment of infection
  - Vaccination for prophylaxis
  - Expectorants
  - Bronchodilators
  - Appropriate chest therapy
    - Including postural drainage and percussion
  - Low-flow oxygen
  - Nutritional supplements

Bronchiectasis

- Usually a secondary condition
- Irreversible abnormal dilation of the medium-sized bronchi (primarily)
  - May be saccular or elongated
- Arises from recurrent inflammation and infection
  - Leads to obstruction of airways, weakening of muscle and elastic fibers in bronchial walls, or both
- Stagnation leads to infections.

Restrictive Lung Disorders

- Group of disorders with impaired lung expansion and reduced total lung capacity
- **First group**
  - **Abnormality of chest wall—**limits or impairs lung expansion
    - Kyphosis or scoliosis, poliomyelitis, amyotrophic lateral sclerosis, botulism, muscular dystrophy
- **Second group**
  - Diseases affecting the supporting framework of lungs
    - Idiopathic **pulmonary fibrosis**, occupational diseases

Pneumoconioses

- Chronic restrictive diseases resulting from long-term exposure to irritating particles
- Inflammation—gradual destruction of connective tissue and scarring.
  - Functional areas of the lungs lost
- Onset insidious
  - Dyspnea develops first
- Treatment—ending exposure, treatment of infection

Pneumoconioses (Cont.)

Disease	Agent	Occurrence
Coal workers disease or anthracosis	Coal dust	Coal mines
Silicosis	Silica	Stone-cutting, sand-blasting, mines
Asbestosis	Asbestos	Insulation, shipbuilding
Farmer's lung	Fungal spores	Hay

Expansion Disorders

Atelectasis

- Nonaeration or collapse of lung or part of a lung
  - Leads to decreased gas exchange and hypoxia
- Alveoli become airless.
  - Collapse and inflammation or atrophy occur.
- Process interferes with blood flow through the lung.
- Both ventilation and perfusion are altered.
  - Affects oxygen diffusion

Atelectasis (Cont.)

- Mechanisms that can result in atelectasis
  - Obstructive or resorption atelectasis
    - Caused by total obstruction of airway
  - Compression atelectasis
    - Mass or tumor exerts pressure on part of the lung.
  - Increased surface tension in alveoli
    - Prevents expansion of lung
  - Fibrotic tissue in lungs or pleura
    - May restrict expansion and lead to collapse
  - Postoperative atelectasis
    - Can occur after surgery

Pleural Effusion

- Presence of excessive fluid in the pleural cavity
- Causes increased pressure in pleural cavity
  - Separation of pleural membranes
- Exudative effusions
  - Response to inflammation
- Transudate effusions
  - Watery effusions (hydrothorax)
  - Result of increased hydrostatic pressure or decreased osmotic pressure in blood vessels

Pleural Effusion (Cont.)

- Signs and symptoms
  - Dyspnea
  - Cyclic chest pain
  - Increased respiratory and heart rates
- Treatment
  - Remove underlying cause to treat respiratory impairment.
  - Analyze fluid to confirm cause.
  - Chest drainage, thoracocentesis to remove fluid and relieve pressure

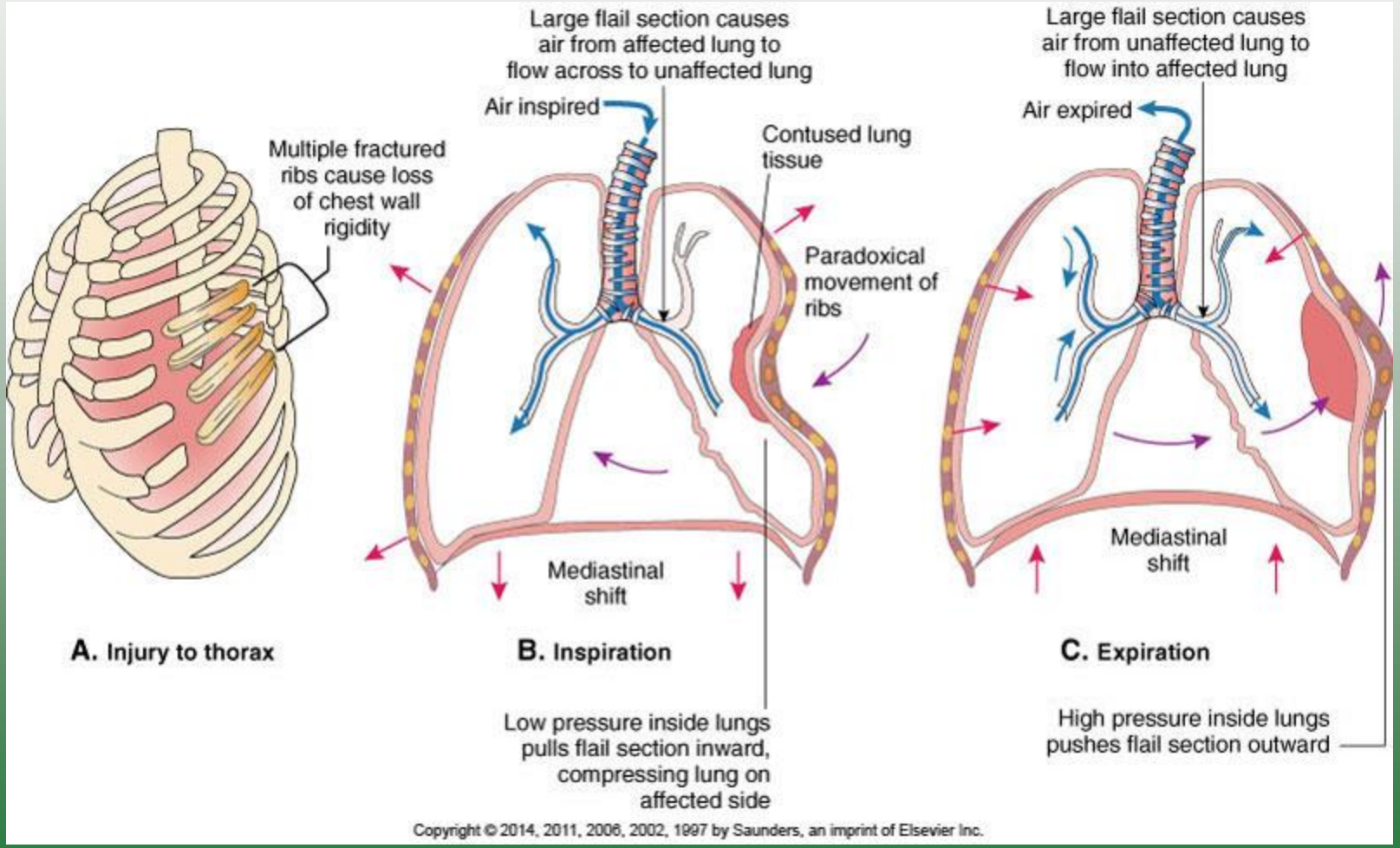
Pneumothorax

- Air in pleural cavity
- Closed pneumothorax
  - Air can enter pleural cavity from internal airways—no opening in chest wall
  - Simple or spontaneous pneumothorax
    - Tear on the surface of the lung
  - Secondary pneumothorax
    - Associated with underlying respiratory disease
    - Rupture of an emphysematous bleb on lung surface or erosion by a tumor or tubercular cavitation

Pneumothorax (Cont.)

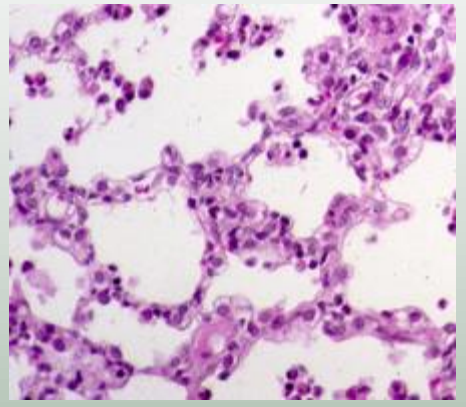
- Open pneumothorax
  - Atmospheric air enters the pleural cavity though an opening in the chest wall.
  - “Sucking” wound
    - Large opening in chest wall
  - Tension pneumothorax
    - Most serious form
    - Result of an opening through chest wall and parietal pleura or from a tear in the lung tissue and visceral pleura
    - Air entry into pleural cavity on inspiration but hole closes on expiration
    - Trapping air leads to increased pleural pressure and atelectasis

Flail Chest Injury

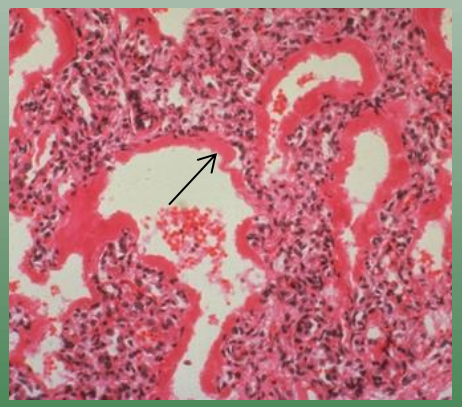


Infant Respiratory Distress Syndrome

- Usually related to premature birth
- Lack of surfactant in alveoli
- Poorly developed alveoli are difficult to inflate.
  - Diffuse atelectasis results.
  - Decreased pulmonary blood flow—pulmonary vasoconstriction—severe hypoxia
- Poor lung perfusion and lack of surfactant
  - Increased alveolar capillary permeability
  - Fluid and protein are leaking into the interstitial area and alveoli, hyaline membrane formation



Normal Lung



Hyaline Membrane Disease

Adult Respiratory Distress Syndrome

- Results from injury to the alveolar wall and capillary membrane
  - Causes the release of chemical mediators
    - Increases permeability of alveolar capillary membranes
    - Increased fluid and protein in interstitial area and alveoli
    - Damage to surfactant-producing cells
    - Diffuse necrosis and fibrosis if patient survives
  - Multitude of predisposing conditions
  - Often associated with multiple organ dysfunction or failure

END OF PART TWO