Inquiry into Life

Eleventh Edition

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Chapter 15
Lecture Outline

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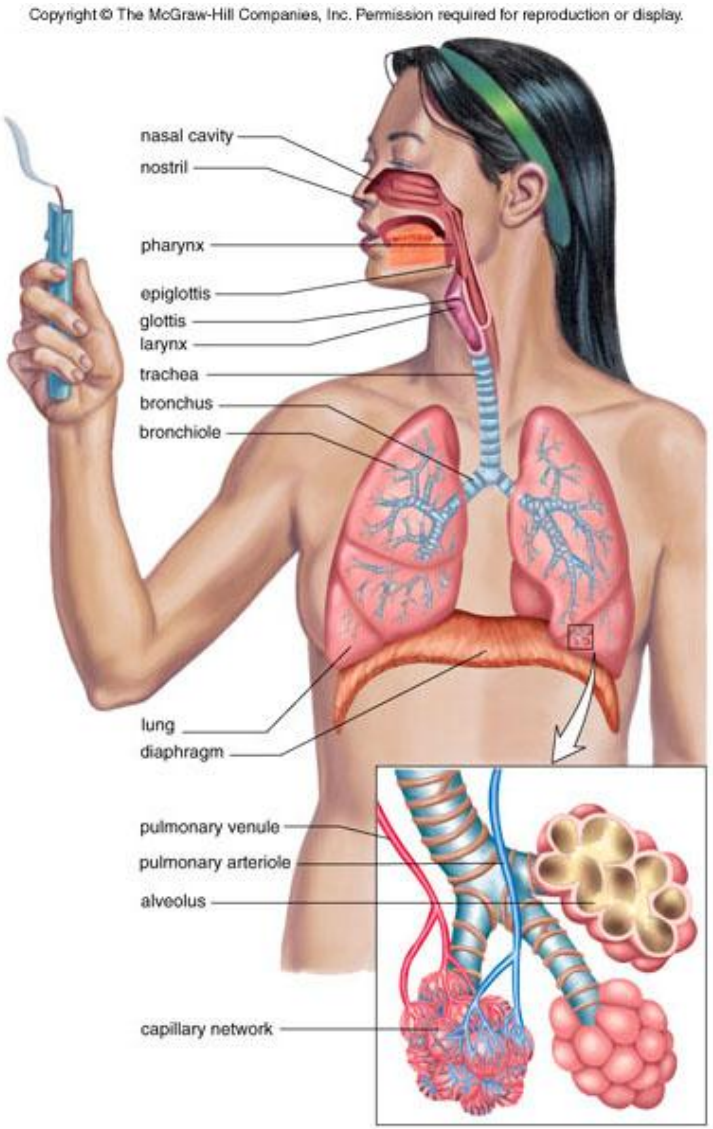
15.1 The respiratory tract

- Overview
  - Inspiration- breathing in
  - Expiration- breathing out
  - Ventilation-encompasses inspiration and expiration
  - Functions
    - External respiration
      - Exchange of gases between air and blood
    - Internal respiration
      - Exchange of gases between blood and tissue fluid
    - Transport of gases

The respiratory tract



- Fig. 15.1

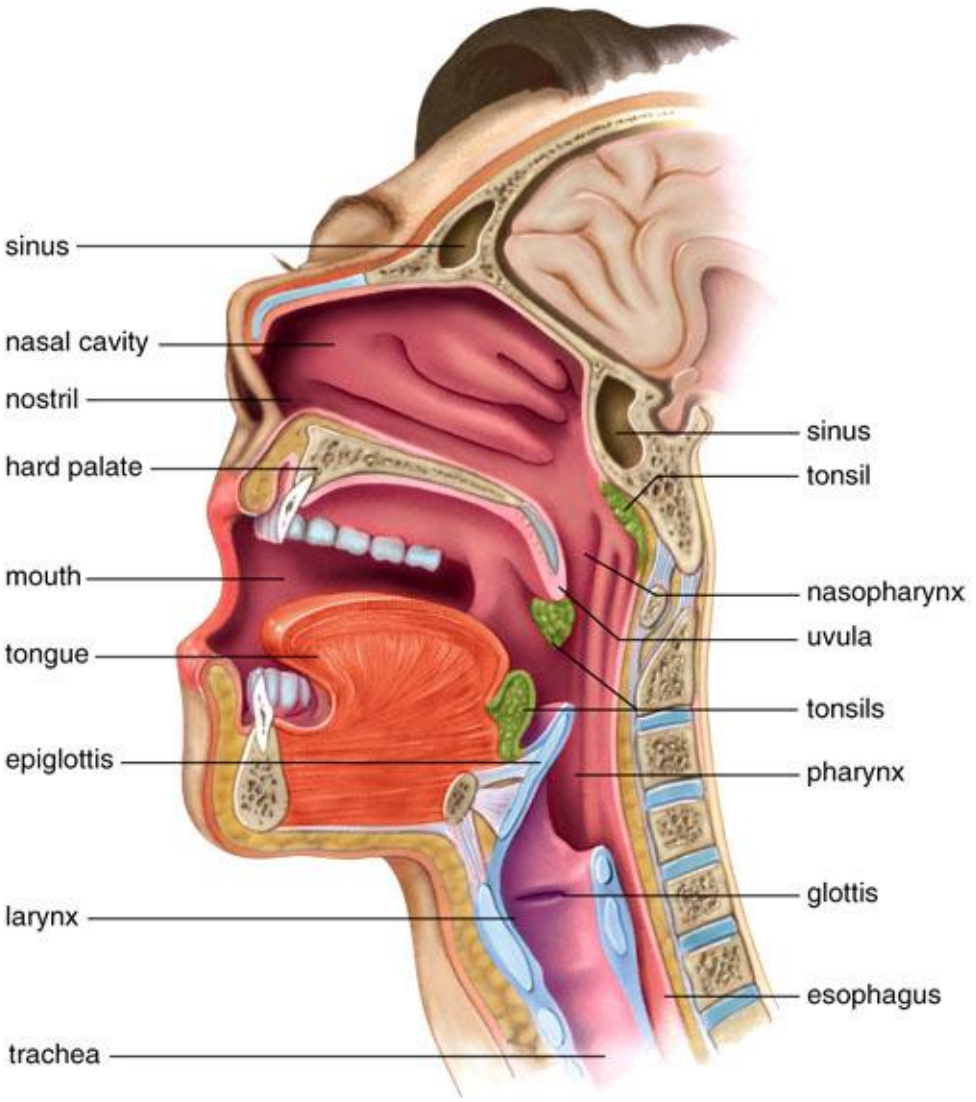
The respiratory tract cont'd.

- The nose
  - Part of upper respiratory tract
  - Contains 2 nasal cavities
    - Communicate with sinuses
    - Lined by mucous membrane
      - Bony ridges increase surface area
    - Functions
      - Warms air- heat from vessels
      - Cleanses air-coarse hairs and mucus
      - Humidifies air-wet surfaces of membrane
    - Olfactory receptors-on cilia high up in cavities
    - Lacrimal glands drain into nasal cavity

The respiratory tract cont'd.

- The pharynx
  - Connects nasal and oral cavities to larynx
  - 3 divisions
    - Nasopharynx
      - Nasal cavities open posterior to soft palate
    - Oropharynx
      - Where oral cavity opens
      - Uvula projects into oropharynx
    - Laryngopharynx
      - Opens into larynx
  - Tonsils form a protective ring
  - Larynx and trachea are normally open
  - Esophagus is normally closed

The path of air

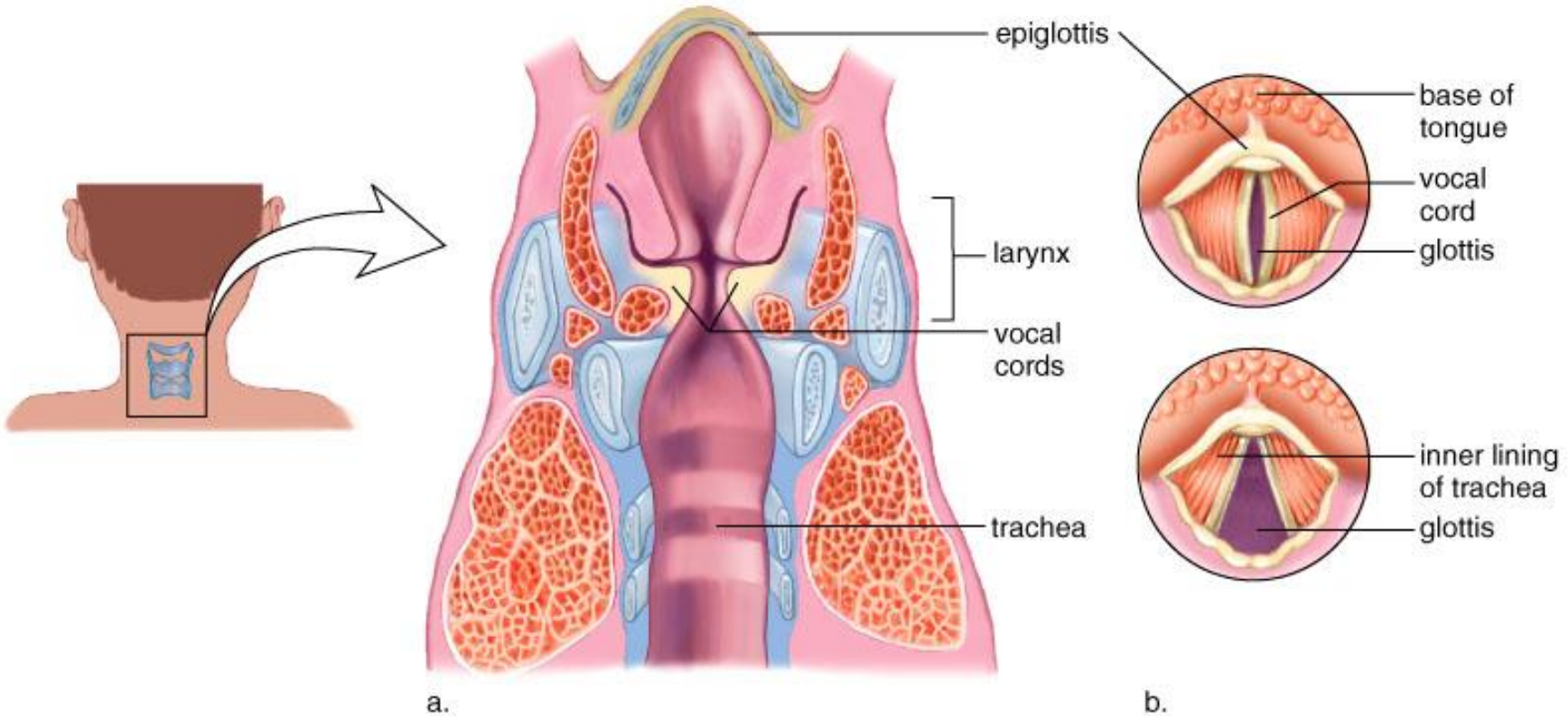


- Fig. 15.2

The respiratory tract cont'd.

- The larynx
  - Passageway for air between pharynx and trachea
  - Vocal folds
    - Folds of mucosa
      - Glottis-opening between folds
    - Supported by elastic ligaments
    - Vibrate during exhalation
      - Pitch controlled by tension
        - » Higher tension-higher pitch
      - Loudness controlled by amplitude of vibration
    - Epiglottis
      - Prevents food from entering during swallowing

Placement of the vocal chord



- Fig. 15.3

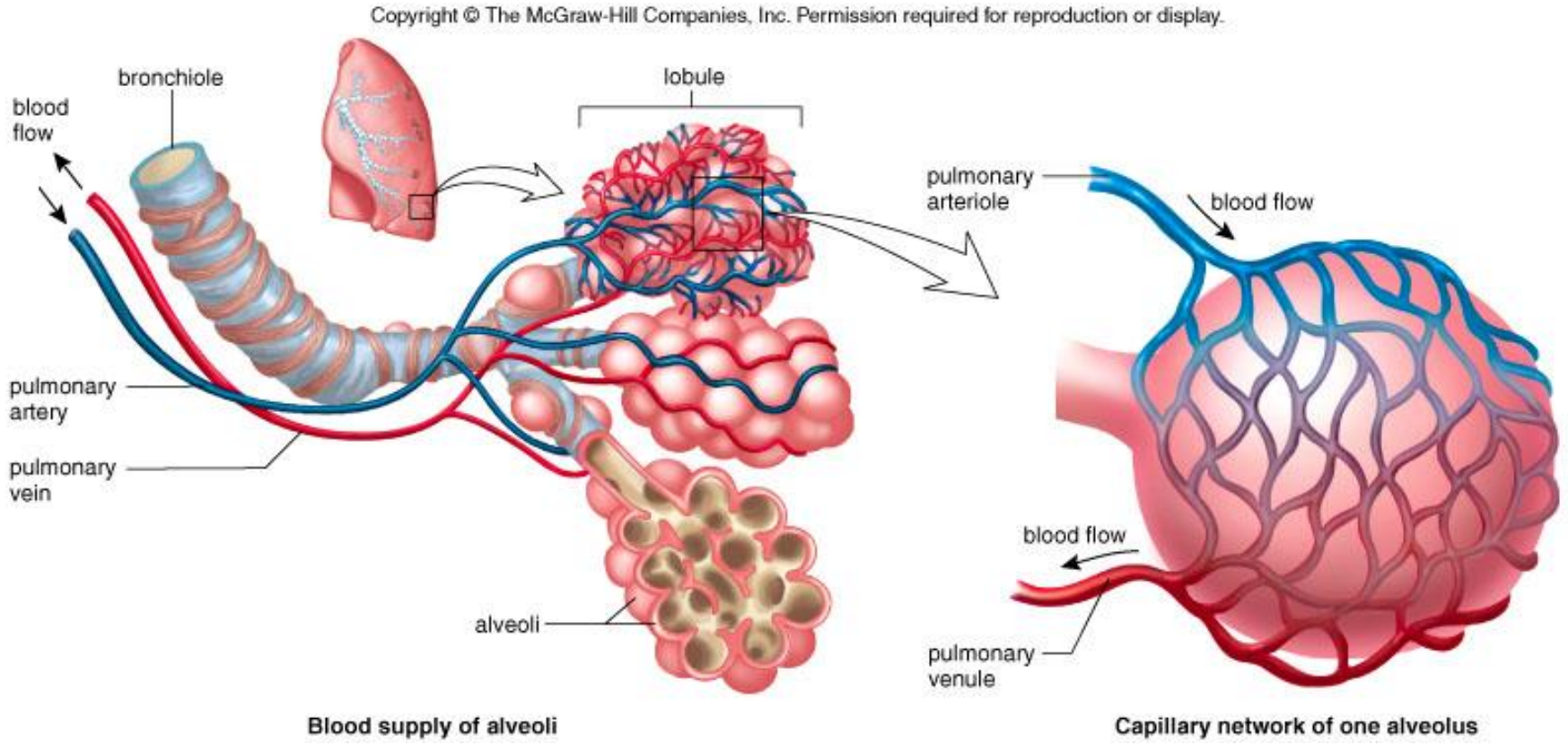
The respiratory tract cont'd.

- The trachea
  - Connects larynx with primary bronchi
  - Supported by C-shaped cartilage rings
    - Keeps trachea patent yet flexible
  - Lined with pseudostratified columnar epithelium
    - Combined action-mucociliary apparatus
      - Mucus traps debris
      - Cilia sweeps mucus and debris upward
    - Smoking paralyzes the mucociliary apparatus
  - Tracheostomy-artificial opening to open airway

The respiratory tract cont'd.

- The bronchial tree
  - Right and left primary bronchi
    - Resemble trachea in structure
  - Branch to secondary bronchi
    - Eventually lead to bronchioles
  - as airways become smaller, walls become thinner
    - Lack cartilage rings
  - Each bronchiole leads into terminal (respiratory) bronchioles
    - Respiratory bronchioles surrounded by alveoli-air sacs

Gas exchange in the lungs



- Fig. 15.4

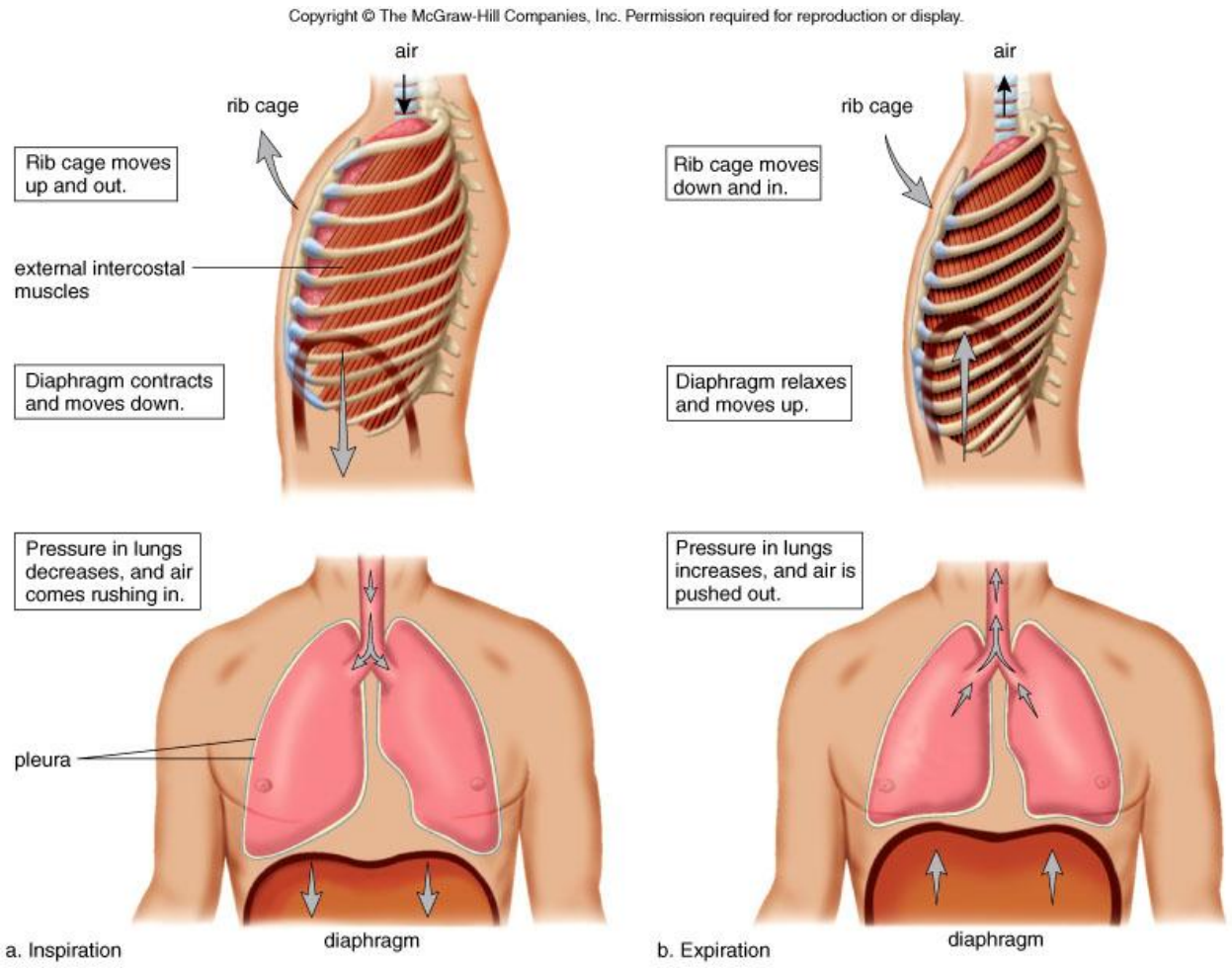
The respiratory tract cont'd.

- The lungs
  - Divided into lobes
    - Right lung has 3
    - Left lung has 2
  - Each lobe is divided into lobules
    - Lobule has a bronchiole serving many alveoli
  - Lungs are covered by serous pleural membrane
    - Double-layered
    - Visceral pleura-on lung surfaces
    - Parietal pleura-on walls of thoracic cavity
    - Surface tension holds the 2 pleural layers together

The respiratory tract cont'd.

- The alveoli
  - Simple squamous epithelium
  - Surrounded by blood capillaries
  - Gas exchange occurs across alveolar wall and capillary wall
    - Oxygen diffuses into blood
    - Carbon dioxide diffuses into alveoli
  - Alveoli must stay open to receive air
    - Surface tension has tendency to make them collapse
    - Surfactant-soapy-like lipoprotein
      - Produced in lungs
      - Lowers surface tension
      - Prevents collapse
    - Infant respiratory distress syndrome-premature babies
      - Lack surfactant; alveoli prone to collapse

Inspiration versus expiration



- Fig. 15.6

Mechanism of breathing

- Control of ventilation
  - Normal rate- 12-20 breaths per minute
  - Controlled by respiratory center
    - In medulla oblongata of brain
    - Inspiration
      - Sends out impulses to diaphragm and external intercostals
      - Causes contraction
    - Expiration
      - Stops sending impulses to those muscles
      - Muscles relax
  - Input to the respiratory center
    - Influenced by chemical and neural input

15.4 Respiration and health

- Upper respiratory tract infections
  - Nasal cavities, larynx, pharynx
  - Infections can spread to sinuses, middle ear
  - Viral infections can lead to secondary bacterial infections
  - "strep throat"
    - *Streptococcus pyogenes*
    - Sore throat, high fever, white patches
  - Sinusitis
    - Nasal congestion blocks sinus openings
    - Postnasal discharge, facial pain
    - Spray decongestants-help drainage

Respiration and health cont'd.

- Upper respiratory tract infections cont'd.
  - Otitis media
    - Middle ear infection
    - Spreads from nasal cavity through eustachian tubes
    - Pain is primary symptom
    - Antibiotics, typanostomoy tubes for recurrent
  - Tonsillitis
    - Inflammation of tonsils
    - Tonsillectomy
      - » Fewer done today
      - » Importance of tonsils recognized

Respiration and health cont'd.

- Upper respiratory tract infections cont'd.
  - Laryngitis
    - Infection of larynx
    - Hoarseness
    - Persistant hoarseness without upper respiratory infection
      - Could indicate cancer

Respiration and health cont'd.

- Lower respiratory infections
  - Acute bronchitis
    - Infection of primary and secondary bronchi
    - Usually secondary infection
    - Deep cough
    - Expectoration of mucus, pus
  - Pneumonia
    - Infection of lungs
    - Viral or bacterial
    - Alveoli and bronchioles fill with fluid
    - High fever, chills, chest pain
    - Can be generalized or isolated to specific lobes
    - *Pneumocytis carinii* pneumonia- AIDS patients

Respiration and health cont'd.

- Lower respiratory infections cont'd.
  - Pulmonary tuberculosis
    - Tubercle bacillis- bacterium
    - Infected tissue encapsulates bacteria-tubercle
    - State of immune system determines course
      - If competent, infection generally walled off
      - If compromised, infection spreads
    - Treated by antibiotics
      - Individuals are quarantined
      - Tine test

Respiration and health cont'd.

- Lower respiratory infections cont'd.
  - Restrictive pulmonary disorders
    - Vital capacity is reduced
    - Lungs lose elasticity
    - Pulmonary fibrosis
      - Inhalation of particles
        - » Silica, asbestos, coal dust
      - Lungs cannot inflate normally

Respiration and health cont'd.

- Obstructive pulmonary disorders
  - Decreased air flow
  - Chronic bronchitis
    - Airways inflammed
    - Productive cough
    - Degenerative changes in bronchi
      - Loss of mucociliary apparatus
    - Smoking, pollutants can predispose
  - Emphysema
    - Alveoli distended
    - Loss of surface area for gas exchange
    - Air trapped in lungs due to alveoli damage
    - Increased workload on heart
    - Supplemental oxygen, drug therapy, exercise may help

Respiration and health cont'd.

- Obstructive pulmonary disorders
  - Asthma
    - Lower airway sensitivity
    - Smooth muscle constriction in bronchioles
    - Produces "musical" wheezing
    - Chemical mediators in bronchioles cause bronchospasm
    - Inhalant medications, bronchodilators
- Lung cancer
    - Progressive steps
    - Thickening and callusing of mucosa of bronchi
    - Loss of cilia
    - Cancerous changes occur in callus cells

Normal lung versus cancerous lung

a.

b.

- Fig. 15.10