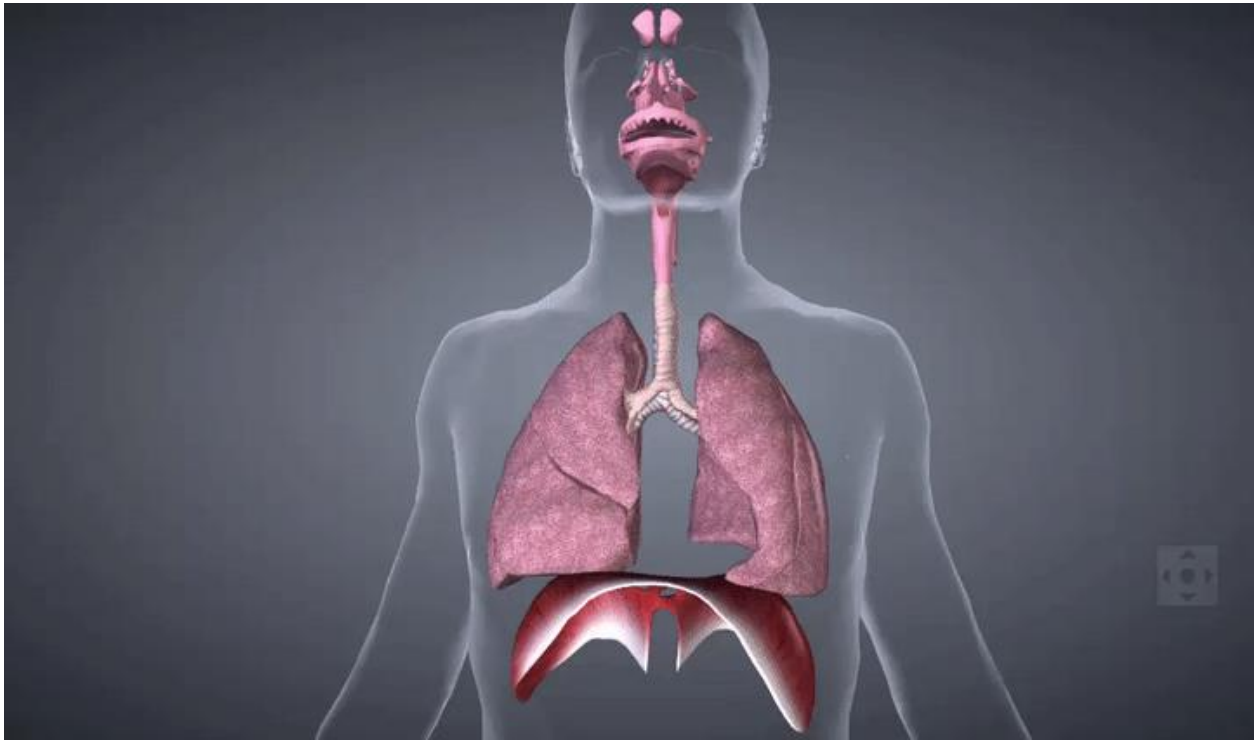
The Respiratory System



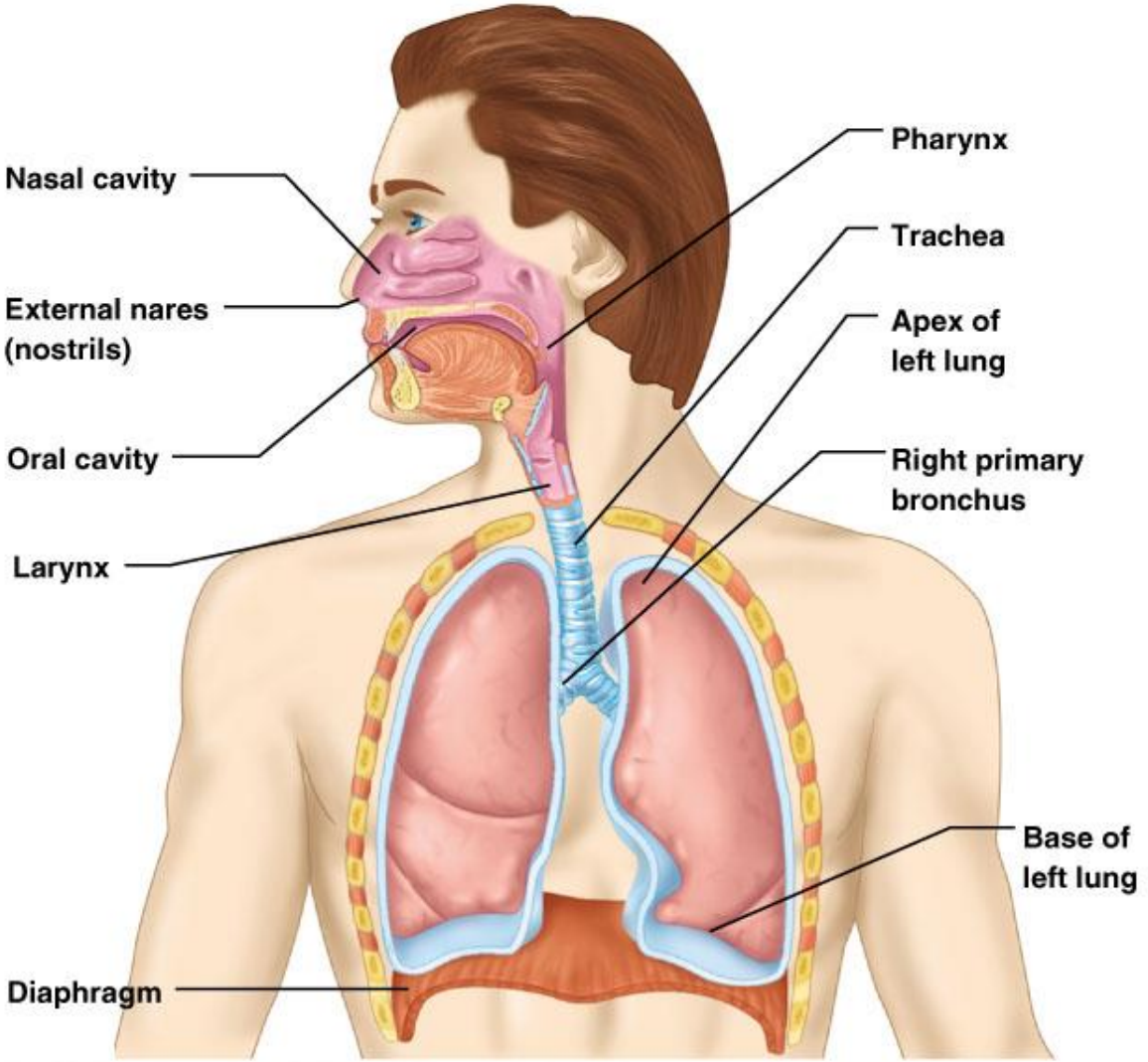
Ms. Mais Abdelhaq

Function of the Respiratory System

- Gas exchanges (oxygen and carbon dioxide) between the blood and external environment
- Exchange of gasses takes place within the lungs in the alveoli
- Passageways to the lungs purify, warm, and humidify the incoming air
- Shares responsibility with cardiovascular system

Organs of the Respiratory system

- Nose
- Pharynx
- Larynx
- Trachea
- Bronchi
- Lungs – alveoli



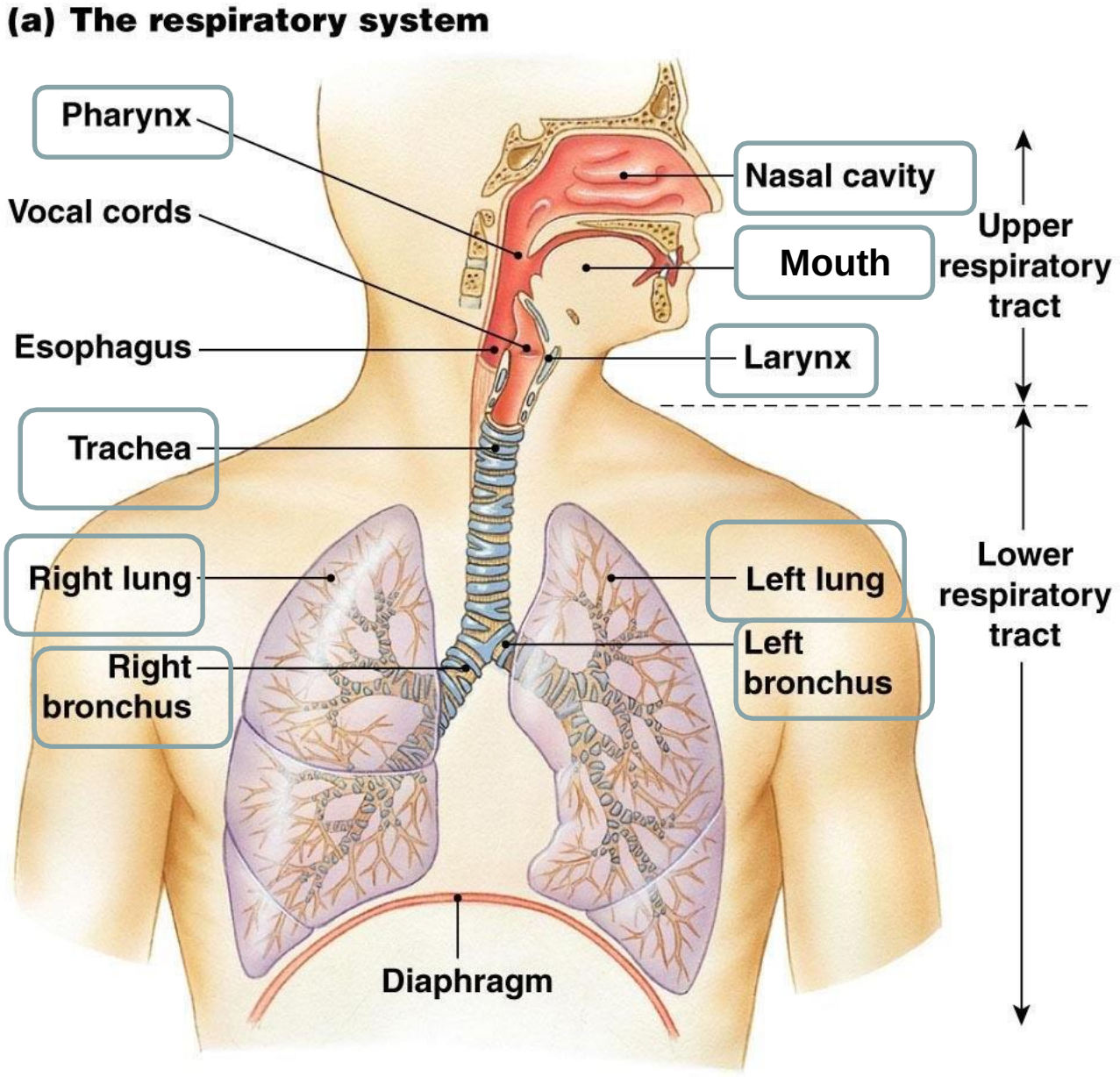


Figure 17-2a

Respiratory System

- Consists of the respiratory and conducting zones
- Respiratory zone:
  - Site of gas exchange
  - Consists of bronchioles, alveolar ducts, and alveoli
- Conducting zone:
  - Conduits for air to reach the sites of gas exchange
  - Includes all other respiratory structures (e.g., nose, nasal cavity, pharynx, trachea)

Upper Respiratory Tract

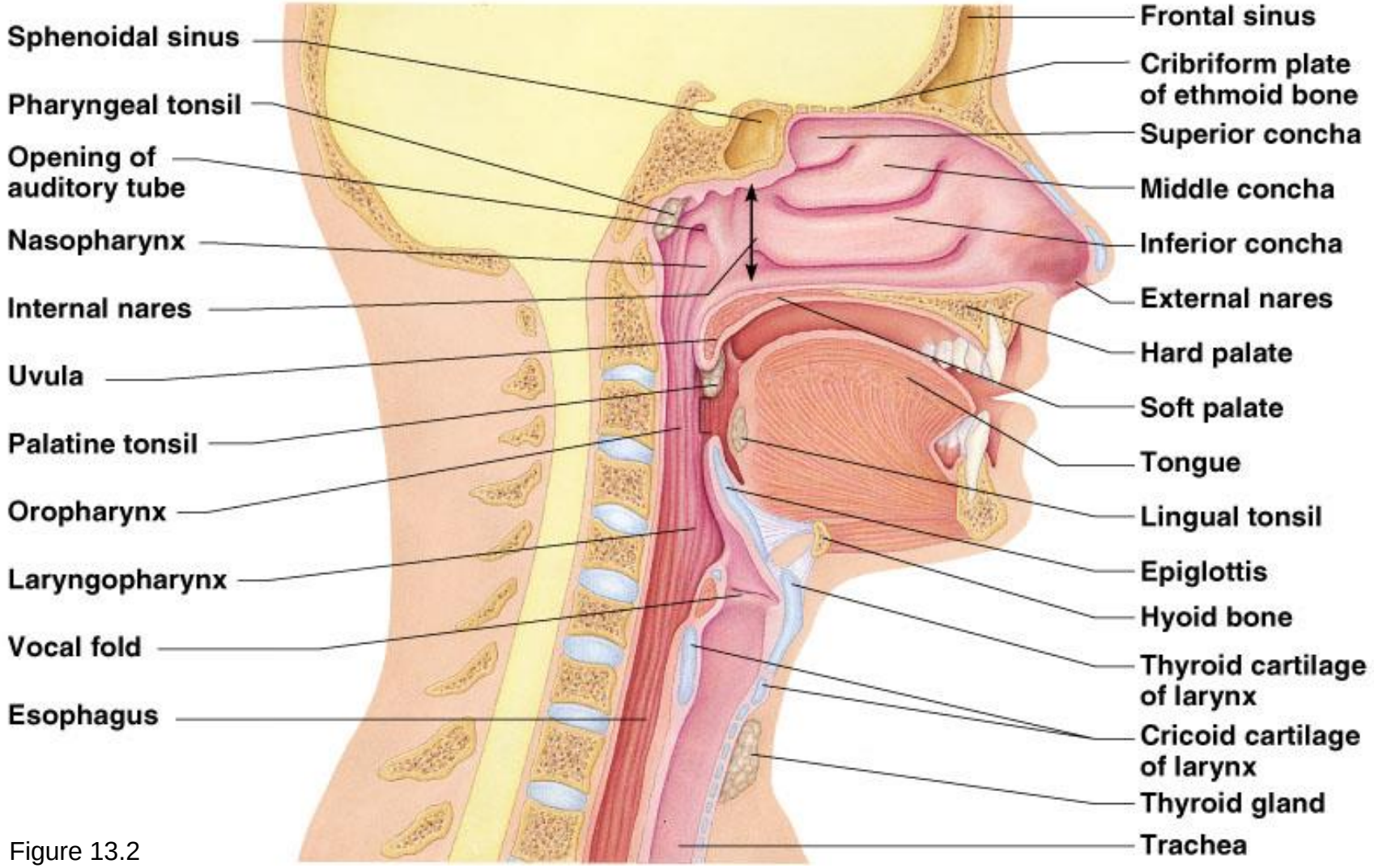


Figure 13.2

Anatomy of the Nasal Cavity

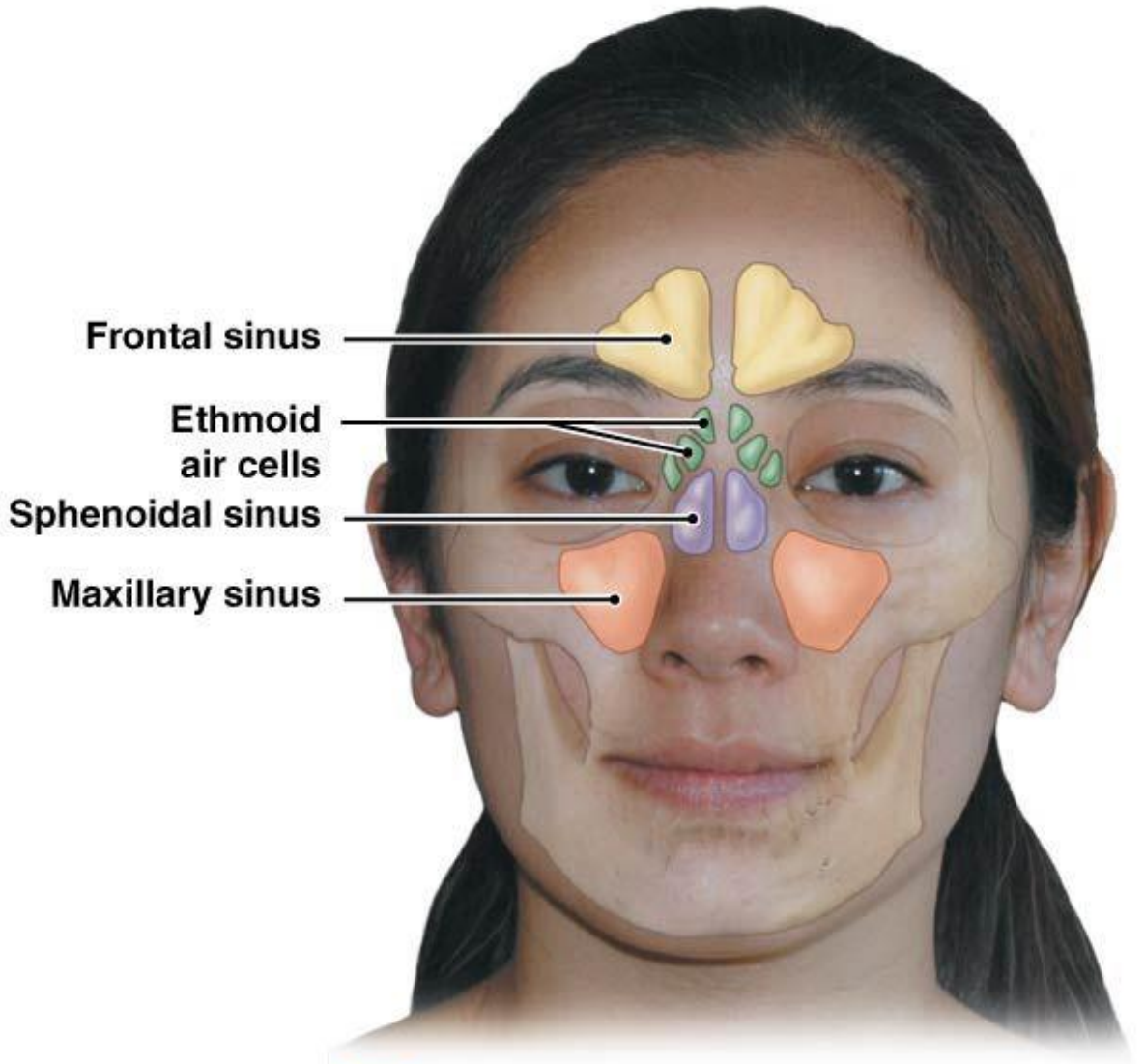
- Olfactory receptors are located in the mucosa on the superior surface
- The rest of the cavity is lined with respiratory mucosa
  - Moistens air
  - Traps incoming foreign particles

Anatomy of the Nasal Cavity

- Lateral walls have projections called conchae
  - Increases surface area
- The nasal cavity is separated from the oral cavity by the palate
  - Anterior hard palate (bone)
  - Posterior soft palate (muscle)

Paranasal Sinuses

- Cavities within bones surrounding the nasal cavity
  - Frontal bone
  - Sphenoid bone
  - Ethmoid bone
  - Maxillary bone



a Locations of the paranasal sinuses.

Paranasal Sinuses

- Function of the sinuses
  - Lighten the skull
  - Act as resonance chambers for speech
  - Produce mucus that drains into the nasal cavity

Pharynx (Throat)

- Muscular passage from nasal cavity to larynx
- Three regions of the pharynx
  - Nasopharynx – superior region behind nasal cavity
  - Oropharynx – middle region behind mouth
  - Laryngopharynx – inferior region attached to larynx
- The oropharynx and laryngopharynx are common passageways for air and food

Upper Respiratory Tract

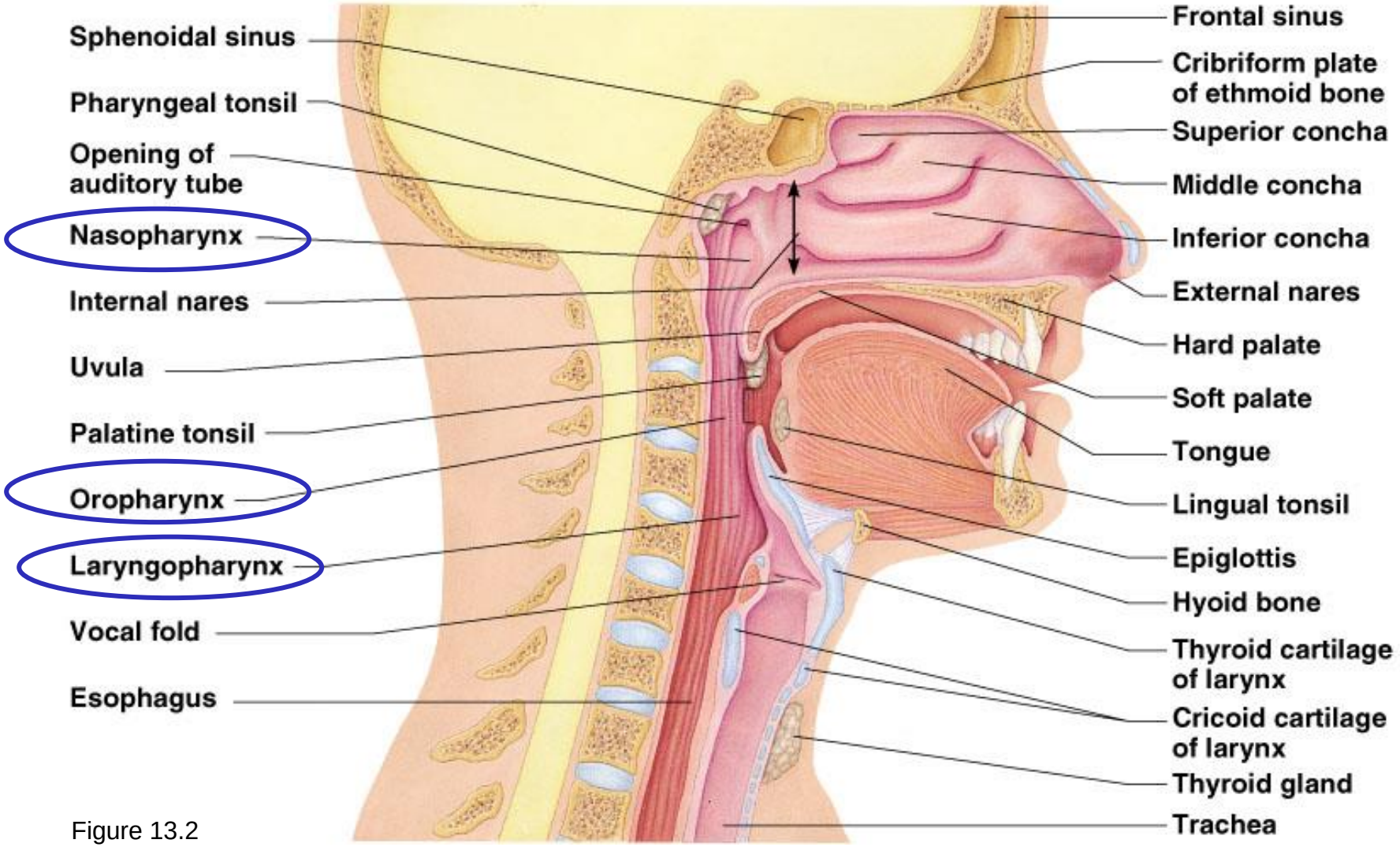


Figure 13.2

Larynx (Voice Box)

- Routes air and food into proper channels
- Plays a role in speech
- Made hyaline cartilages and a spoon-shaped flap of elastic cartilage (epiglottis)

Structures of the Larynx

- Thyroid cartilage
  - Largest hyaline cartilage
  - Protrudes anteriorly (Adam's apple)
- Epiglottis
  - Superior opening of the larynx
  - Routes food to the esophagus and air toward the trachea

Framework of the Larynx

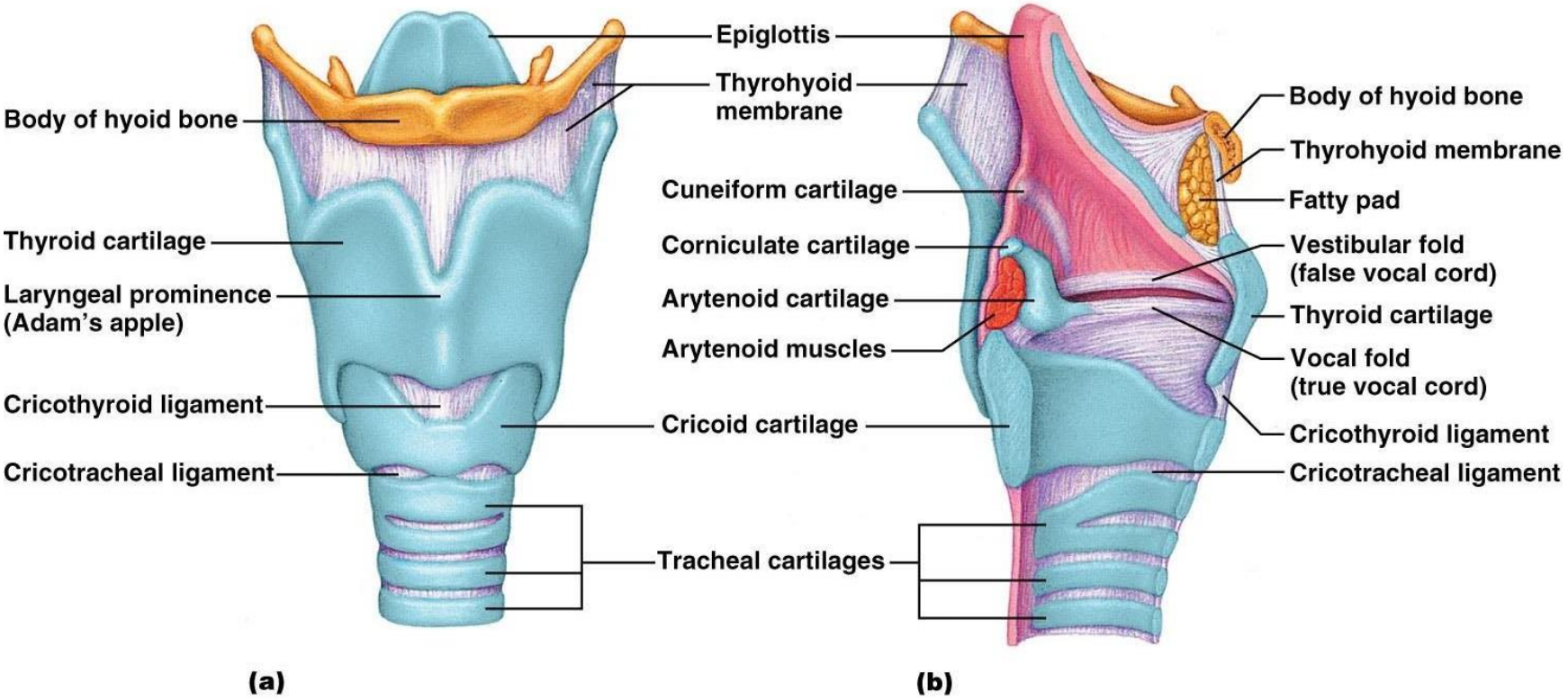


Figure 22.4a, b

Structures of the Larynx

- Vocal cords (vocal folds)
  - Vibrate with expelled air to create sound (speech)
- Glottis – opening between vocal cords

Movements of Vocal Cords

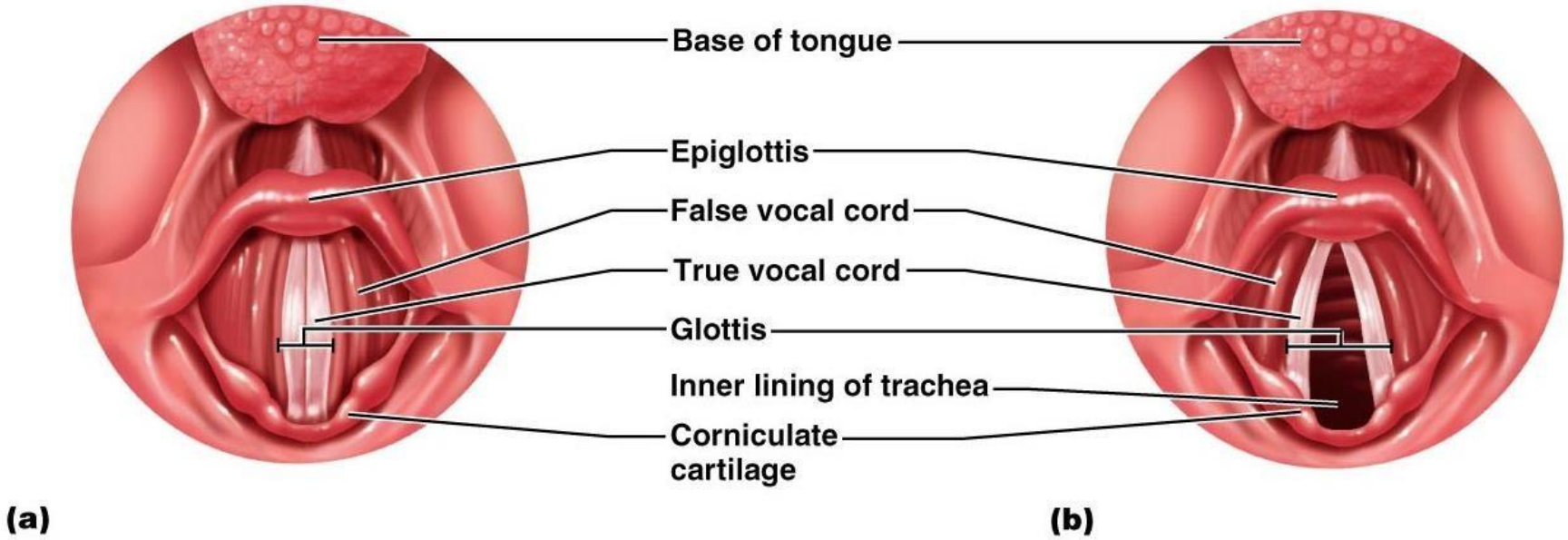


Figure 22.5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Trachea (Windpipe)

- Connects larynx with bronchi
- Lined with ciliated mucosa
- Walls are reinforced with C-shaped hyaline cartilage

Primary Bronchi

- Formed by division of the trachea
- Enters the lung at the hilus (medial depression)
- Right bronchus is wider, shorter, and straighter than left
- Bronchi subdivide into smaller and smaller branches

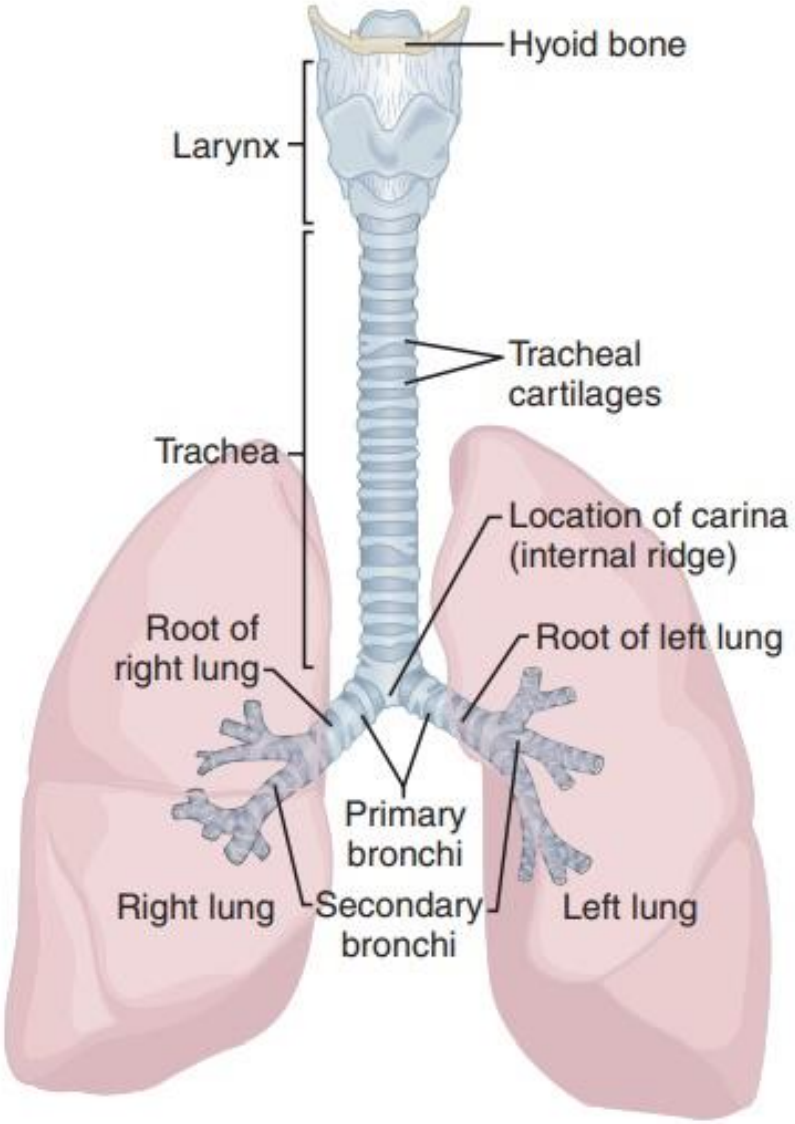
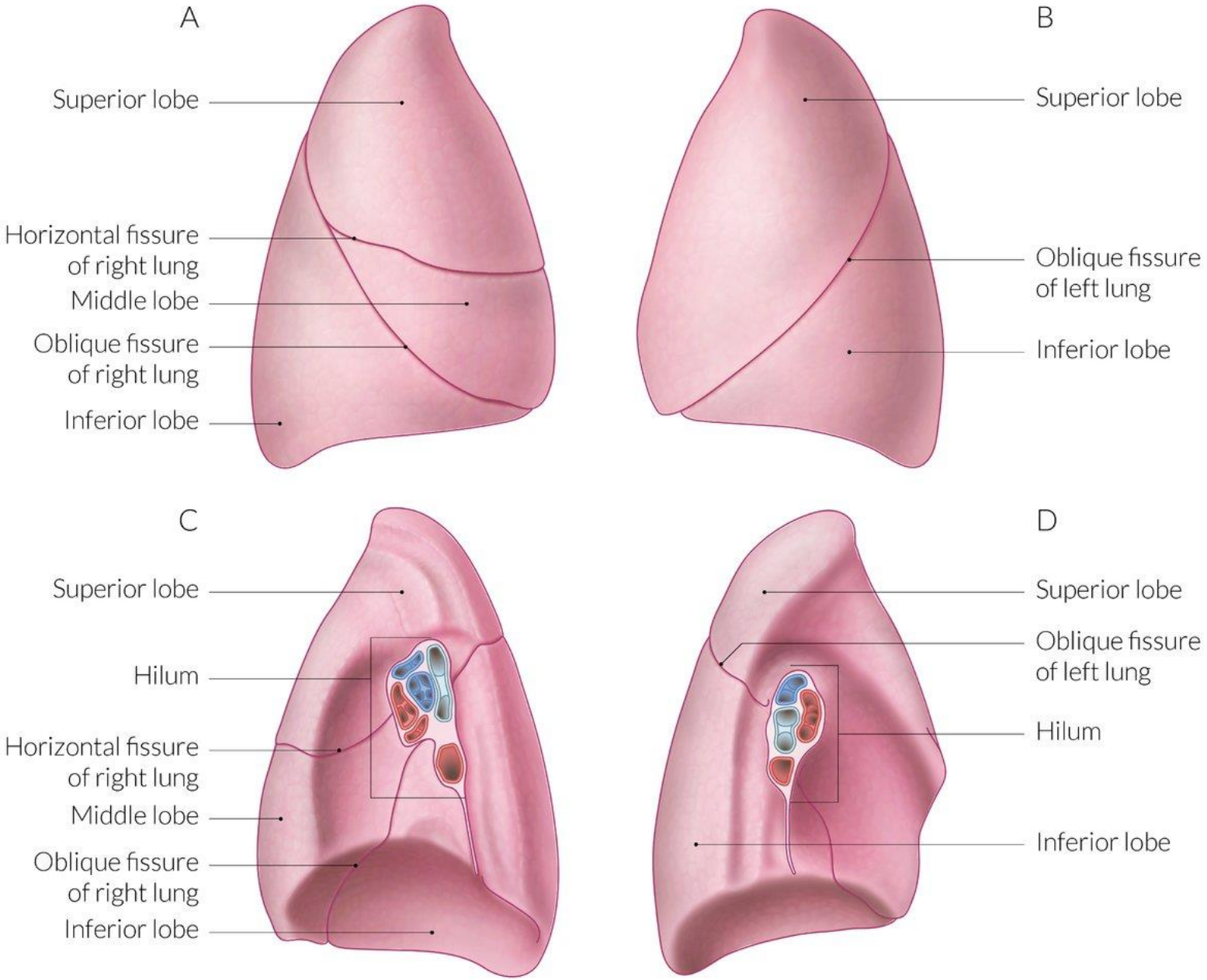


FIGURE 21-5 The structures of the trachea.

Lungs

- Occupy most of the thoracic cavity
  - Apex is near the clavicle (superior portion)
    - Base rests on the diaphragm (inferior portion)
  - Each lung is divided into lobes by fissures
    - Left lung – two lobes
    - Right lung – three lobes


A
Superior lobe
Horizontal fissure of right lung
Middle lobe
Oblique fissure of right lung
Inferior lobe
B
Superior lobe
Oblique fissure of left lung
Inferior lobe
C
Superior lobe
Hilum
Horizontal fissure of right lung
Middle lobe
Oblique fissure of right lung
Inferior lobe
D
Superior lobe
Oblique fissure of left lung
Hilum
Inferior lobe

Lungs

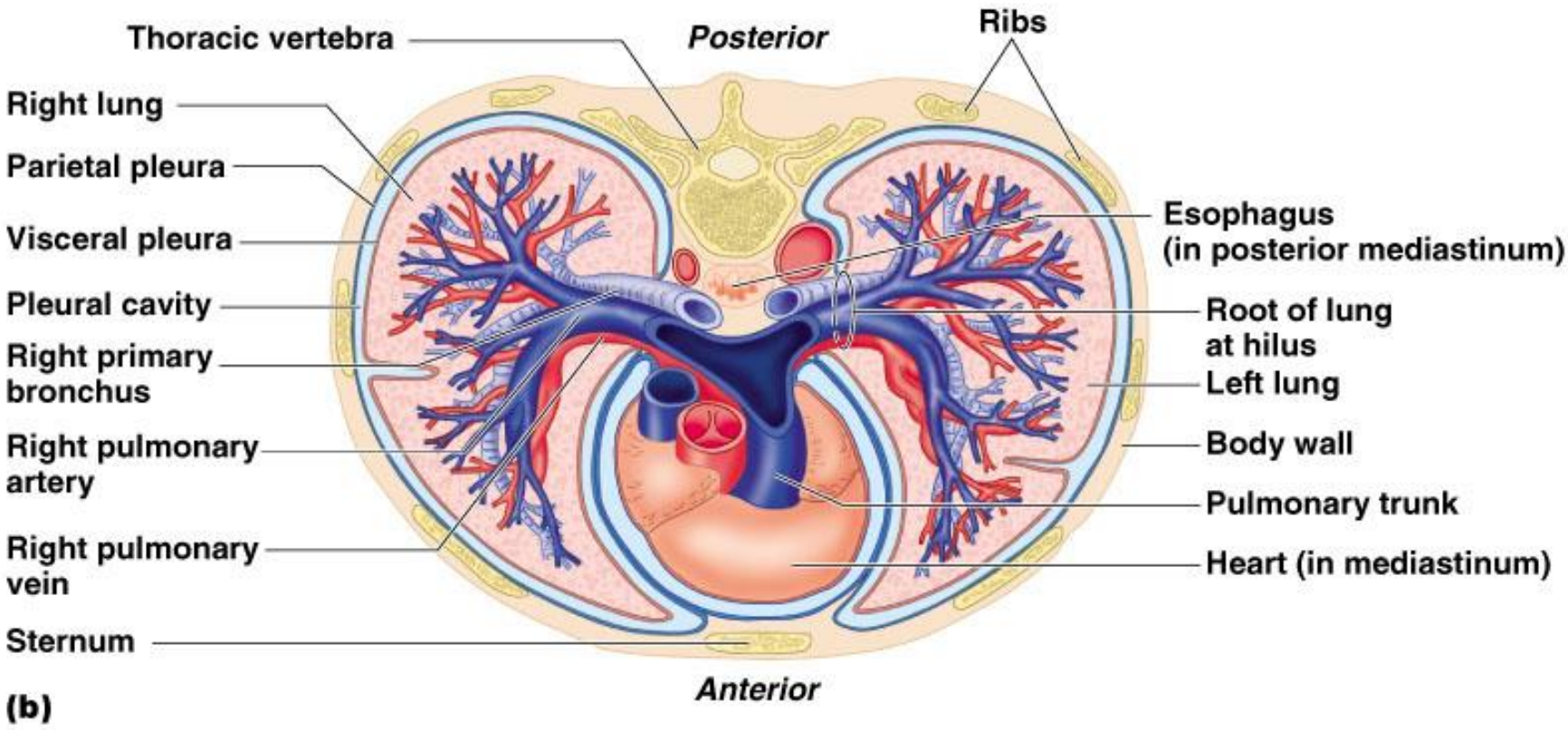
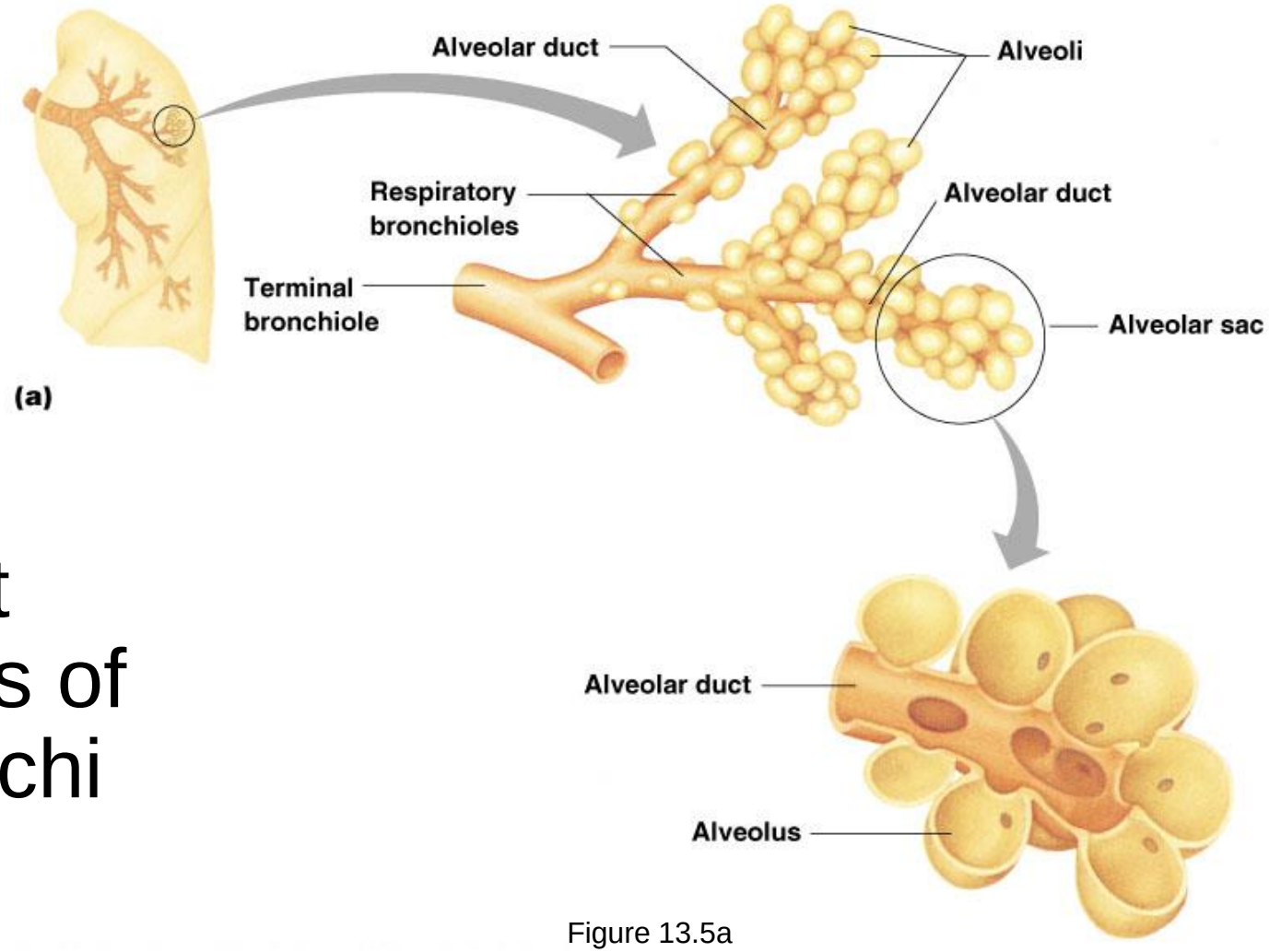


Figure 13.4b

Bronchioles

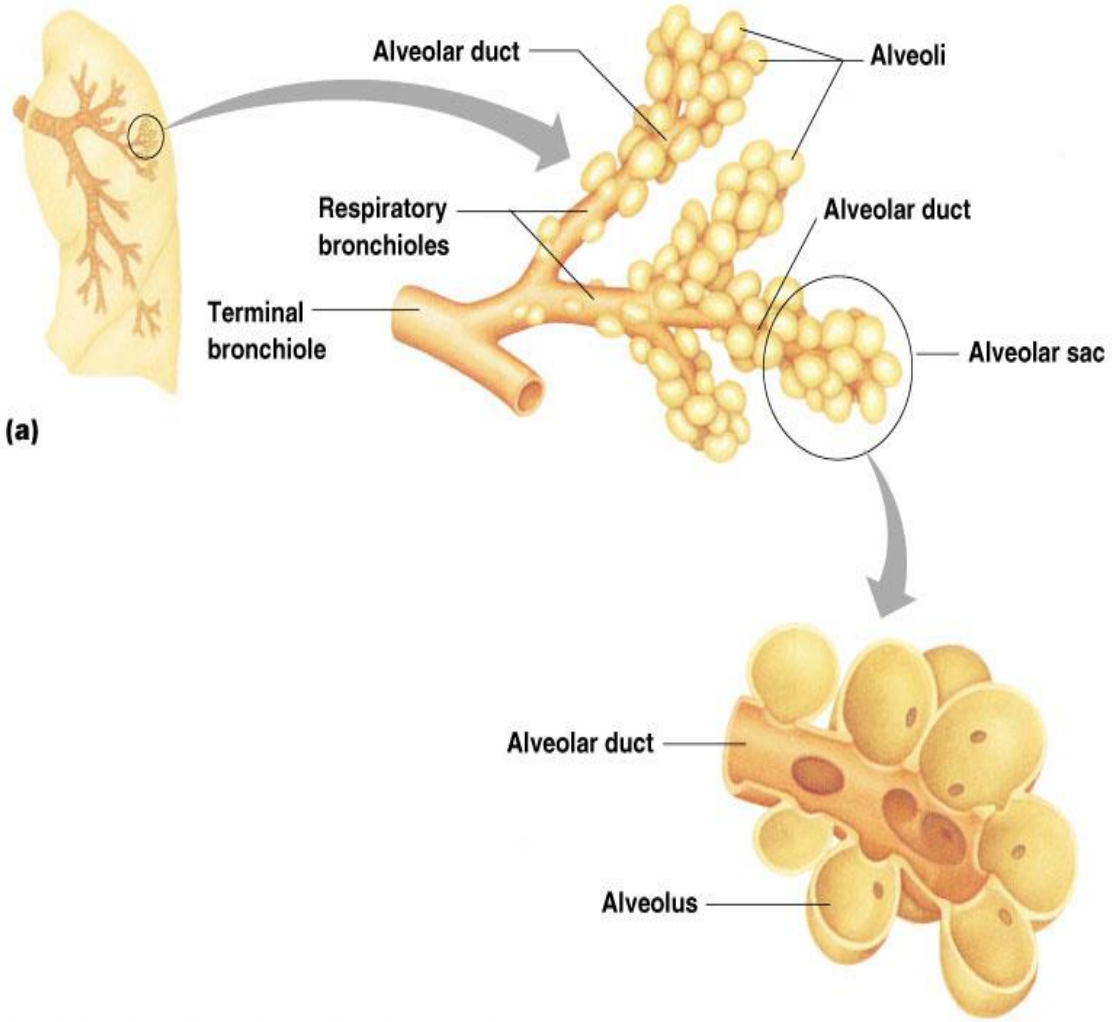


- Smallest branches of the bronchi

Figure 13.5a

Alveoli

- Structure of alveoli
  - Alveolar duct
  - Alveolar sac
  - Alveolus
  - Gas exchange



Respiratory Membrane (Air-Blood Barrier)

- Composed of:
  - Alveolar and capillary walls
  - Basal laminas fused
- Alveolar walls:
  - Are a single layer of type I epithelial cells
  - Permit gas exchange by simple diffusion
  - Secrete angiotensin converting enzyme (ACE)
- Type II cells secrete surfactant

Respiratory Membrane (Air-Blood Barrier)

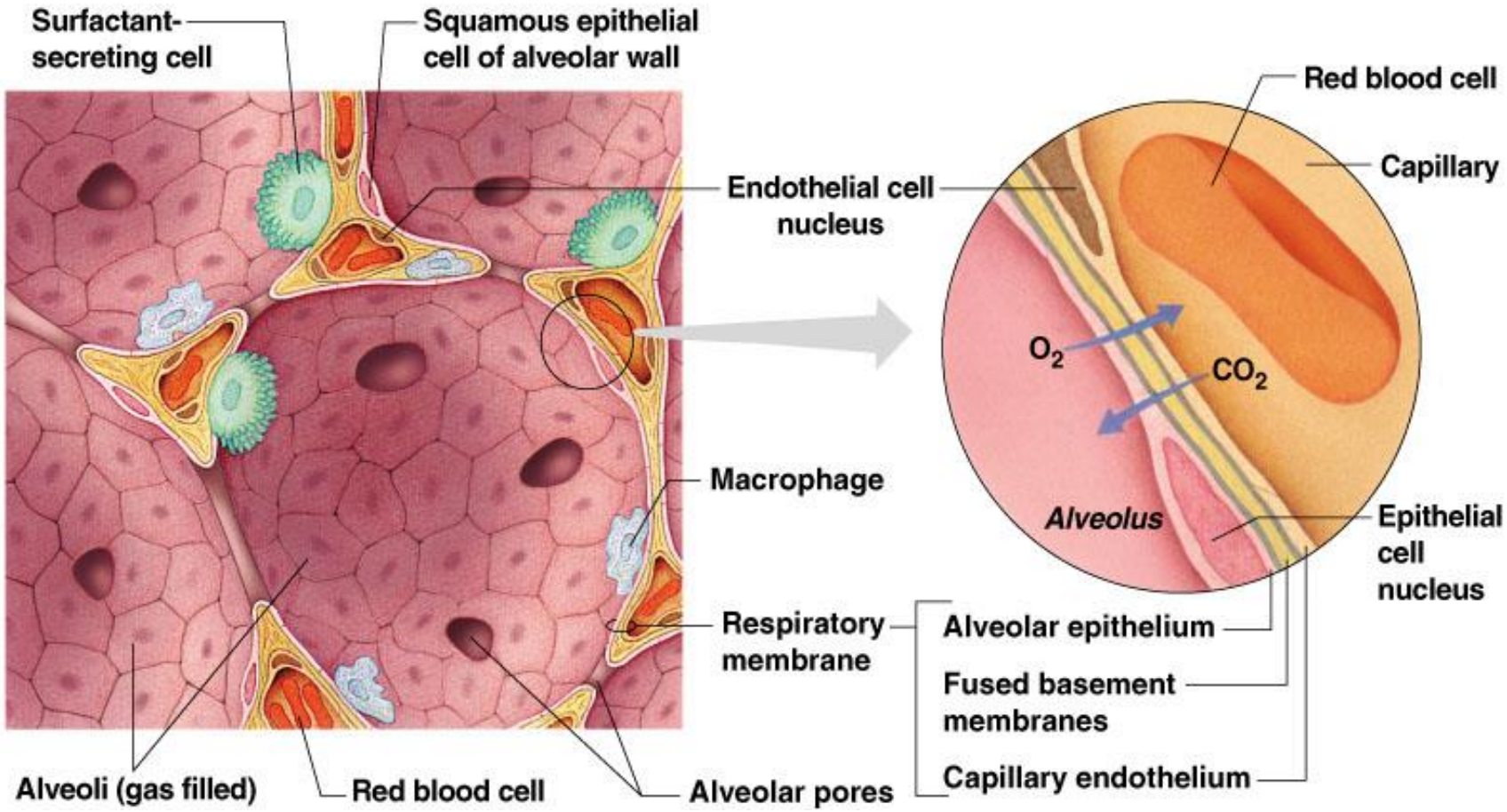


Figure 13.6

Events of Respiration

- 4 distinct processes:
- **Pulmonary ventilation** – moving air in and out of the lungs
- **External respiration** – gas exchange between pulmonary blood and alveoli
- **Transport** – transport of oxygen and carbon dioxide between the lungs and tissues
- **Internal respiration** – gas exchange between systemic blood vessels and tissues

Mechanics of Breathing (Pulmonary Ventilation)

- Completely mechanical process
- Depends on volume changes in the thoracic cavity
- Volume changes lead to pressure changes, which lead to the flow of gases to equalize pressure

Mechanics of Breathing (Pulmonary Ventilation)

- Two phases
  - Inspiration – flow of air into lung
  - Expiration – air leaving lung

Inspiration

- Diaphragm and intercostal muscles contract
- The size of the thoracic cavity increases
- External air is pulled into the lungs due to an increase in intrapulmonary volume

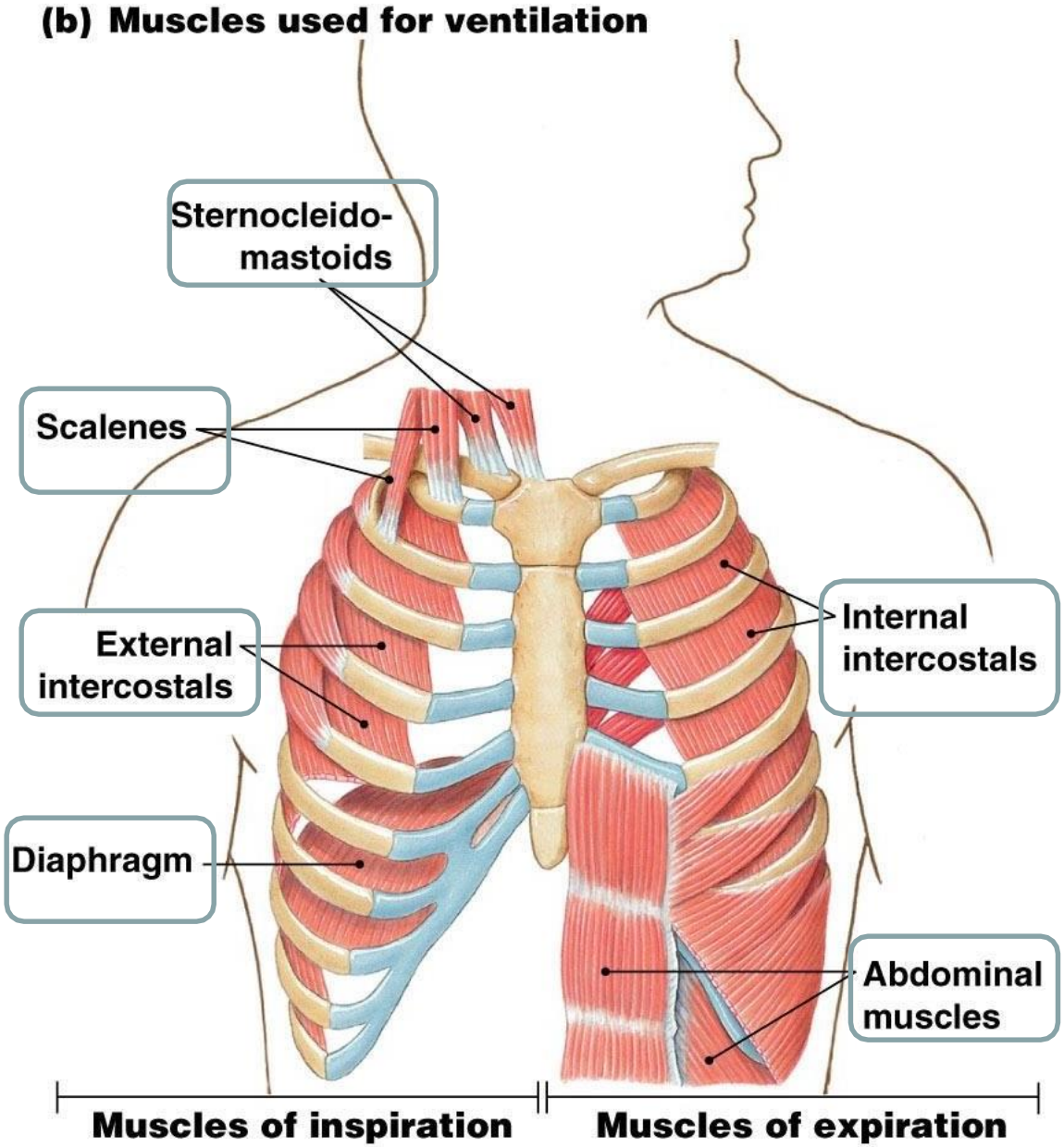


Figure 17-2b

Inspiration

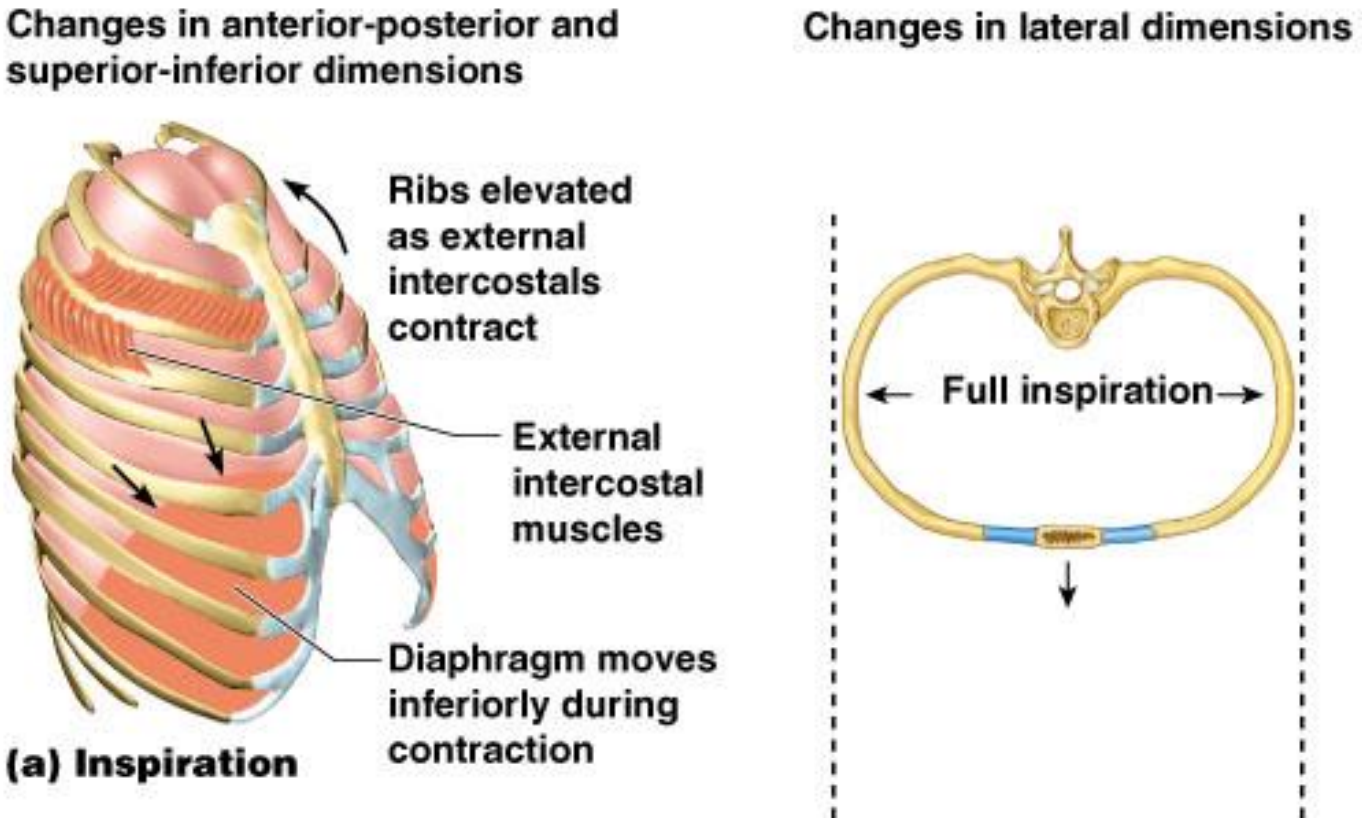


Figure 13.7a

Exhalation

- Largely a passive process which depends on natural lung elasticity
- As muscles relax, air is pushed out of the lungs
- Forced expiration can occur mostly by contracting internal intercostal muscles to depress the rib cage

Exhalation

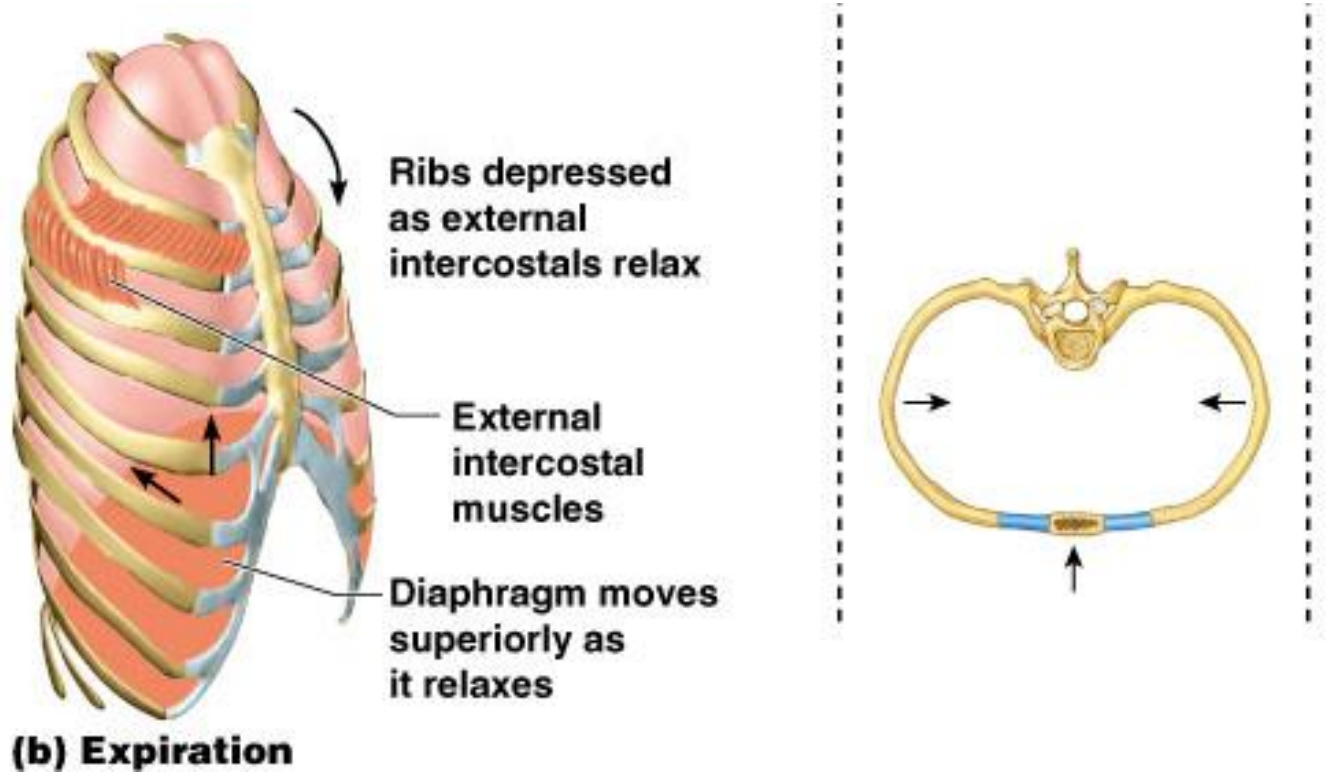
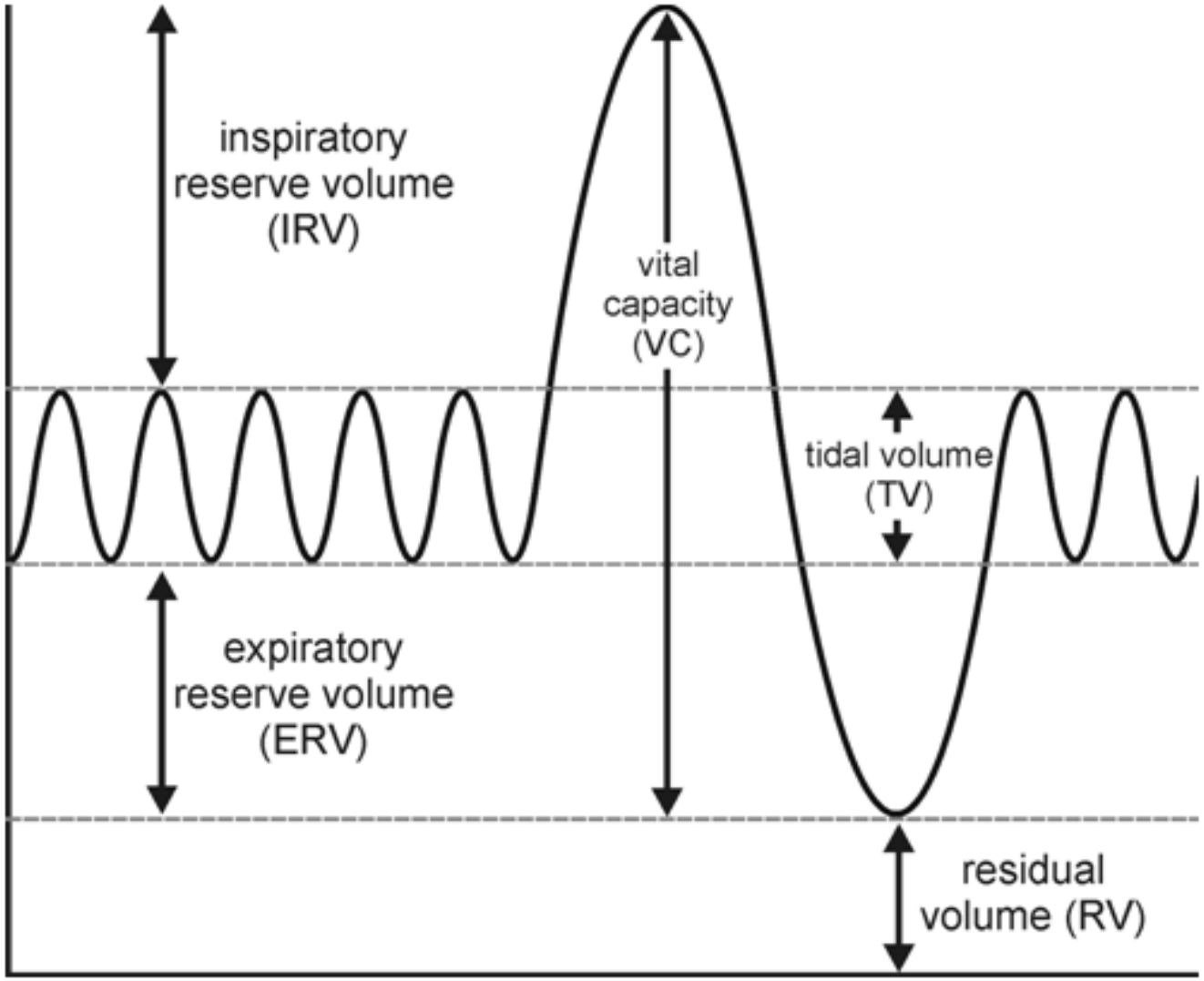


Figure 13.7b

Nonrespiratory Air Movements

- Can be caused by reflexes or voluntary actions
- Examples
  - Cough and sneeze – clears lungs of debris
  - Laughing
  - Crying
  - Yawn
  - Hiccup

Respiratory Volumes &Capacities



Respiratory Volumes and Capacities

- Normal breathing moves about 500 ml of air with each breath (tidal volume [TV])
- Many factors that affect respiratory capacity
  - A person's size
  - Sex
  - Age
  - Physical condition

Respiratory Volumes and Capacities

- Inspiratory reserve volume (IRV)
  - Amount of air that can be taken in forcibly over the tidal volume
  - Usually between 2100 and 3200 ml
- Expiratory reserve volume (ERV)
  - Amount of air that can be forcibly exhaled
  - Approximately 1200 ml

Respiratory Volumes and Capacities

- Residual volume
  - Air remaining in lung after expiration
  - About 1200 ml remains in the lungs

Respiratory Volumes and Capacities

- Vital capacity
  - The total amount of exchangeable air
  - Vital capacity = TV + IRV + ERV

Respiratory capacities are measured with a spirometer

Respiratory Sounds

- Sounds are monitored with a stethoscope
- Bronchial sounds – produced by air rushing through trachea and bronchi
- Vesicular breathing sounds – soft sounds of air filling alveoli

Neural Regulation of Respiration

- Activity of respiratory muscles is transmitted to the brain by the phrenic and intercostal nerves
- Neural centers that control rate and depth are located in the medulla
- The pons appears to smooth out respiratory rate
- Normal respiratory rate (eupnea) is 12–15 respirations per minute
- Hypernia is increased respiratory rate often due to extra oxygen needs

Neural Regulation of Respiration

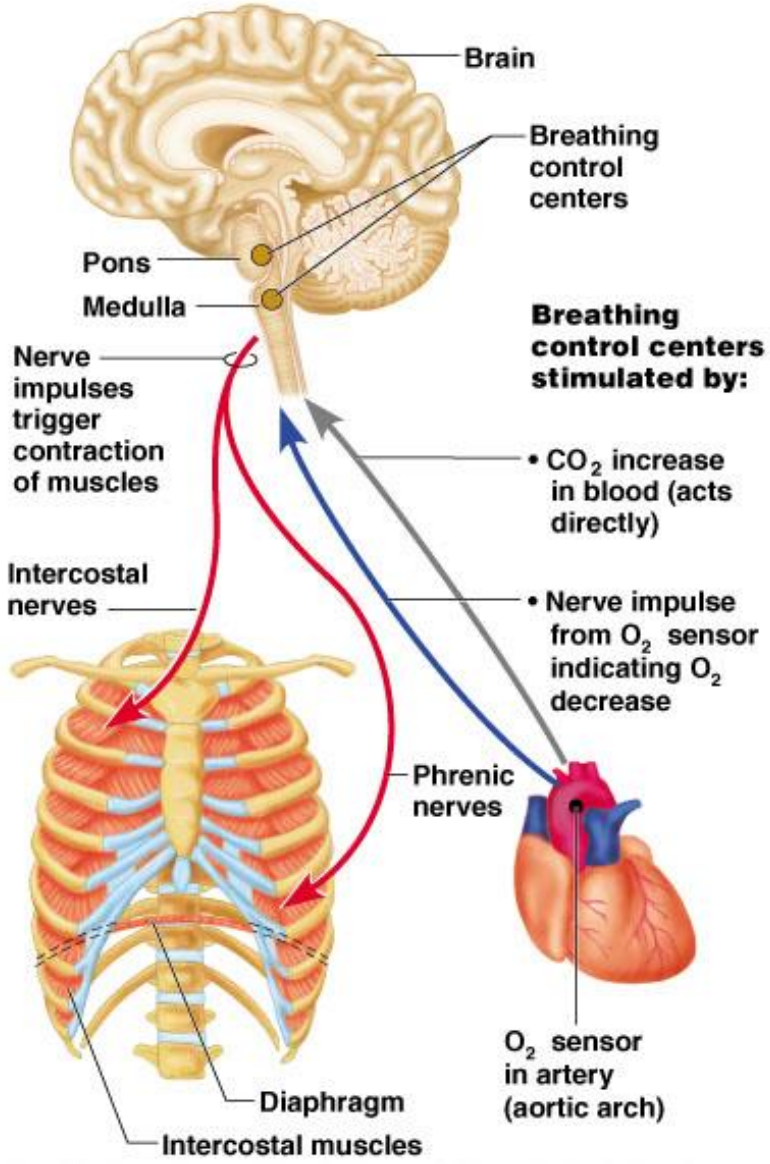


Figure 13.12

Factors Influencing Respiratory Rate and Depth

- Physical factors
  - Increased body temperature
  - Exercise
  - Talking
  - Coughing
- Volition (conscious control)
- Emotional factors

Factors Influencing Respiratory Rate and Depth

- Chemical factors
  - Carbon dioxide levels
    - Level of carbon dioxide in the blood is the main regulatory chemical for respiration
    - Increased carbon dioxide increases respiration
    - Changes in carbon dioxide act directly on the medulla oblongata

Factors Influencing Respiratory Rate and Depth

- Chemical factors (continued)
  - Oxygen levels
    - Changes in oxygen concentration in the blood are detected by chemoreceptors in the aorta and carotid artery
    - Information is sent to the medulla oblongata

Respiratory Disorders: Chronic Obstructive Pulmonary Disease (COPD)

- Exemplified by chronic bronchitis and emphysema
- Major causes of death and disability in the United States

Respiratory Disorders: Chronic Obstructive Pulmonary Disease (COPD)

- Features of these diseases
  - Patients almost always have a history of smoking
  - Labored breathing (dyspnea) becomes progressively more severe
  - Coughing and frequent pulmonary infections are common

Respiratory Disorders: Chronic Obstructive Pulmonary Disease (COPD)

- Features of these diseases (continued)
  - Most victimes retain carbon dioxide, are hypoxic and have respiratory acidosis
  - Those infected will ultimately develop respiratory failure

Emphysema

- Alveoli enlarge as adjacent chambers break through
- Chronic inflammation promotes lung fibrosis
- Airways collapse during expiration
- Patients use a large amount of energy to exhale
- Overinflation of the lungs leads to a permanently expanded barrel chest
- Cyanosis appears late in the disease

Chronic Bronchitis

- Mucosa of the lower respiratory passages becomes severely inflamed
- Mucus production increases
- Pooled mucus impairs ventilation and gas exchange
- Risk of lung infection increases
- Pneumonia is common
- Hypoxia and cyanosis occur early

Chronic Obstructive Pulmonary Disease (COPD)

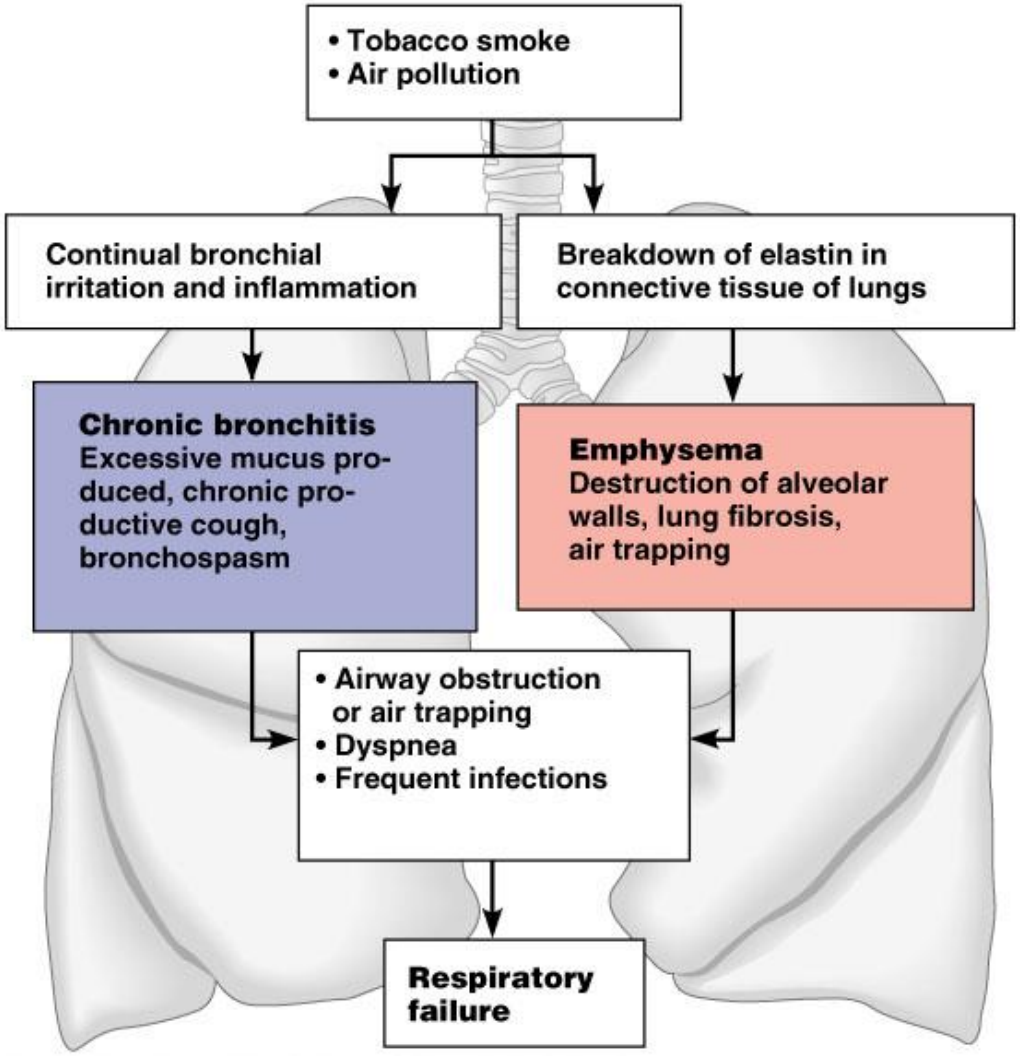


Figure 13.13

Lung Cancer

- Accounts for 1/3 of all cancer deaths in the United States
- Increased incidence associated with smoking
- Three common types
  - Squamous cell carcinoma
  - Adenocarcinoma
  - Small cell carcinoma

Sudden Infant Death syndrome (SIDS)

- Apparently healthy infant stops breathing and dies during sleep
- Some cases are thought to be a problem of the neural respiratory control center
- One third of cases appear to be due to heart rhythm abnormalities

Asthma

- Chronic inflamed hypersensitive bronchiole passages
- Response to irritants with dyspnea, coughing, and wheezing

Aging Effects

- Elasticity of lungs decreases
- Vital capacity decreases
- Blood oxygen levels decrease
- Stimulating effects of carbon dioxide decreases
- More risks of respiratory tract infection

Respiratory Rate Changes Throughout Life

- Newborns – 40 to 80 respirations per minute
- Infants – 30 respirations per minute
- Age 5 – 25 respirations per minute
- Adults – 12 to 18 respirations per minute
- Rate often increases somewhat with old age

Thank You