13
PART B

The Respiratory System

PowerPoint® Lecture Slide Presentation by Jerry L. Cook, Sam Houston University

ESSENTIALS OF HUMAN ANATOMY & PHYSIOLOGY

EIGHTH EDITION

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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

External Respiration

- Oxygen movement into the blood
  - The alveoli always has more oxygen than the blood
  - Oxygen moves by diffusion towards the area of lower concentration
  - Pulmonary capillary blood gains oxygen

External Respiration

- Carbon dioxide movement out of the blood
  - Blood returning from tissues has higher concentrations of carbon dioxide than air in the alveoli
  - Pulmonary capillary blood gives up carbon dioxide
- Blood leaving the lungs is oxygen-rich and carbon dioxide-poor

Gas Transport in the Blood

- Oxygen transport in the blood
  - Inside red blood cells attached to hemoglobin (oxyhemoglobin [HbO_2])
  - A small amount is carried dissolved in the plasma

Gas Transport in the Blood

- Carbon dioxide transport in the blood
  - Most is transported in the plasma as bicarbonate ion (HCO_3^-)
  - A small amount is carried inside red blood cells on hemoglobin, but at different binding sites than those of oxygen

Internal Respiration

- Exchange of gases between blood and body cells
- An opposite reaction to what occurs in the lungs
  - Carbon dioxide diffuses out of tissue to blood
  - Oxygen diffuses from blood into tissue

Internal Respiration

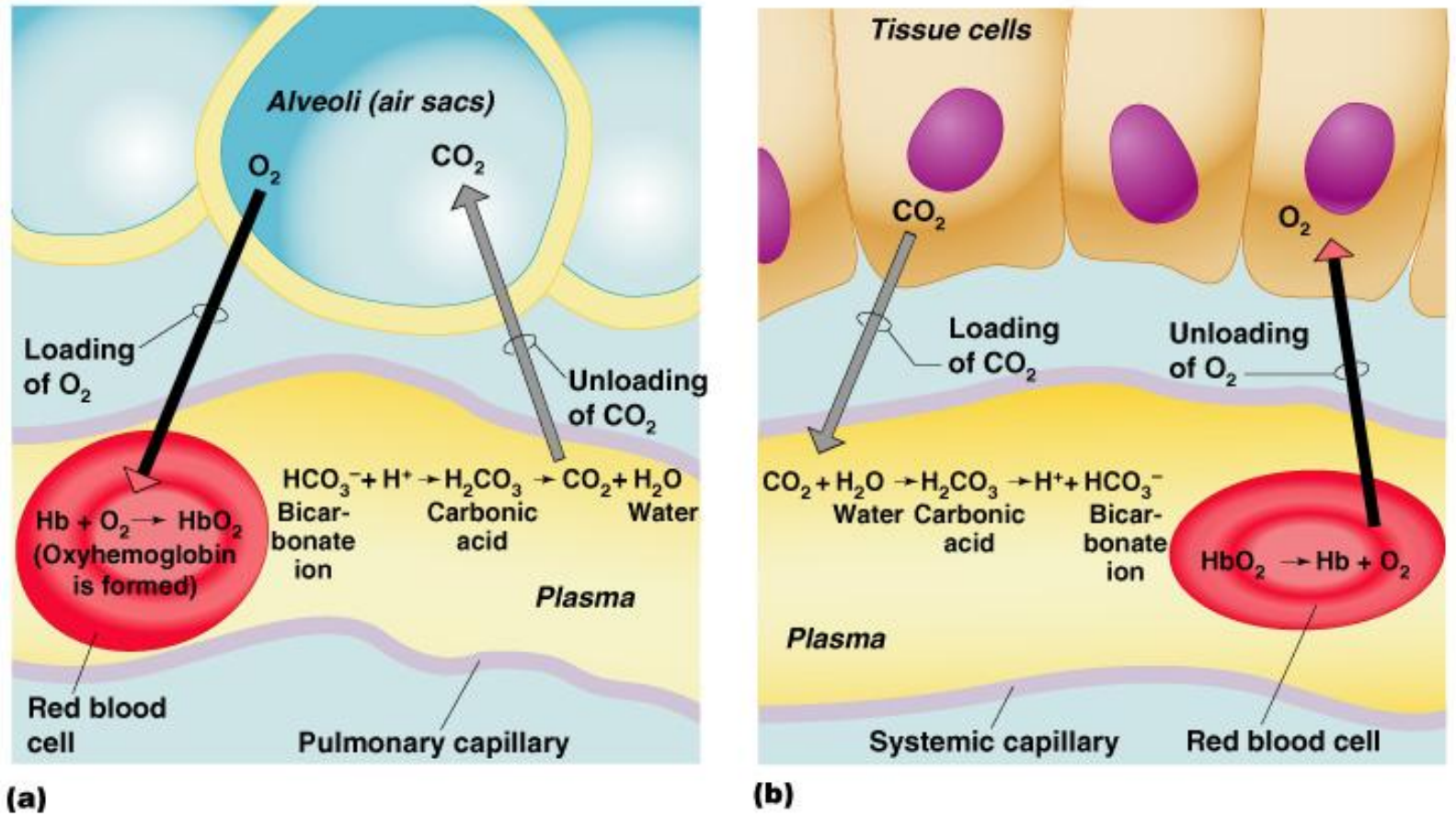

Figure 13.11

External Respiration, Gas Transport, and Internal Respiration Summary

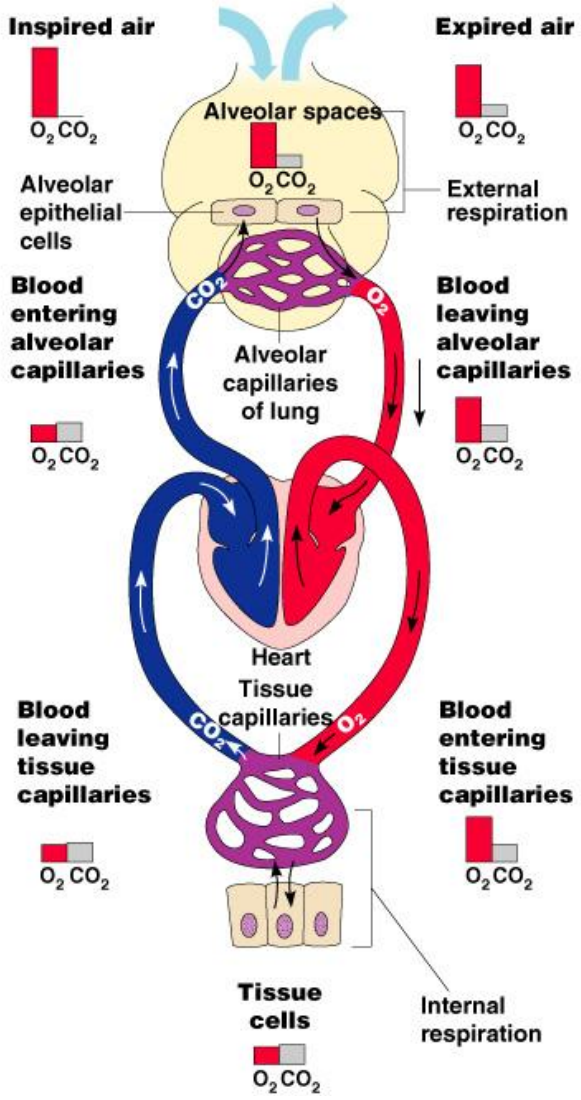

Figure 13.10

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

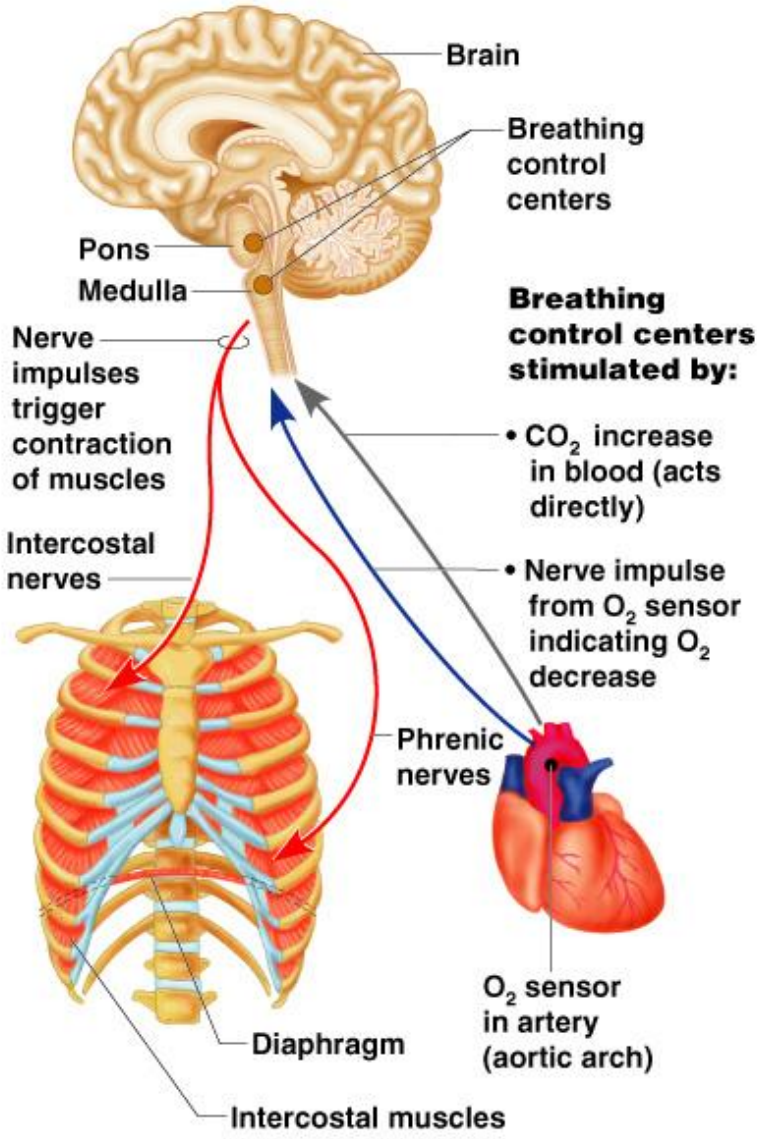

Figure 13.12

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)

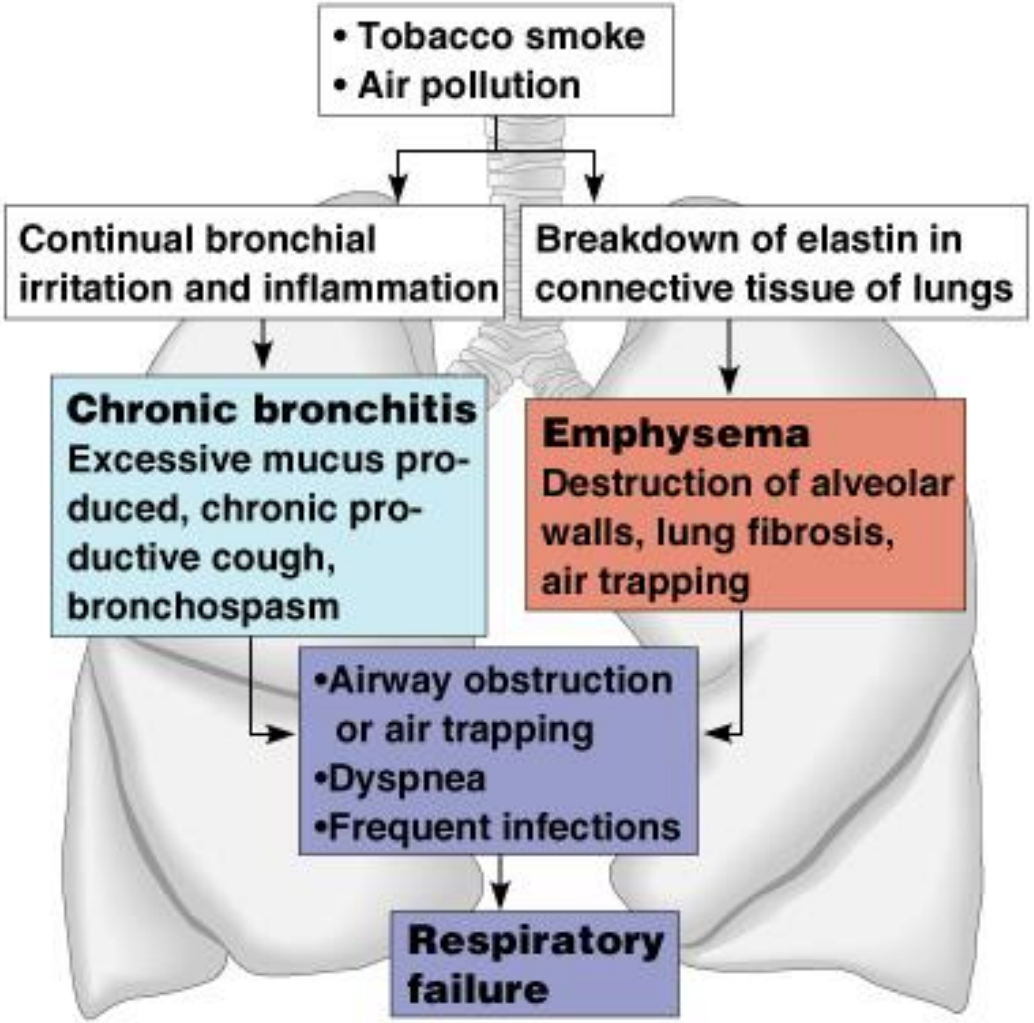

Figure 13.13

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

Developmental Aspects of the Respiratory System

- Lungs are filled with fluid in the fetus
- Lungs are not fully inflated with air until two weeks after birth
- Surfactant that lowers alveolar surface tension is not present until late in fetal development and may not be present in premature babies

Developmental Aspects of the Respiratory System

- Important birth defects
  - Cystic fibrosis – oversecretion of thick mucus clogs the respiratory system
  - Cleft palate

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