

14 The Respiratory System

Chapter Summary

Respiration involves the exchange of gases between the air and the blood, or external respiration; the exchange of gases between the blood and the cells, or internal respiration; and the use of oxygen gas and the production of carbon dioxide gas by the cells. The organs of the respiratory system conduct air to the lungs and include: the nose, pharynx, larynx, trachea, bronchi, bronchioles, and lungs. Gas exchange occurs across the respiratory membrane, which consists of the alveolar epithelium and basement membrane, and the capillary epithelium and basement membrane. Breathing is controlled by the respiratory center in the medulla, and carotid bodies and aortic bodies in the carotid arteries and aorta. The respiratory center is sensitive to carbon dioxide and hydrogen ion concentrations, and the carotid and aortic bodies are sensitive to oxygen, carbon dioxide, and hydrogen ion concentrations. When the levels of hydrogen ions and carbon dioxide rise, the rate and depth of breathing increases. Inspiration is the active phase of breathing and requires the contraction of the diaphragm and rib muscles. As these muscles contract, the thoracic cavity and lungs expand and air rushes in. Expiration occurs when the diaphragm and rib muscles relax. During expiration the lungs recoil and air is pushed out. The amount of air moved into and out of the lungs during normal breathing is called the tidal volume. The maximum amount that can be inhaled and exhaled during a single breath is called the vital capacity. Inspiration beyond the tidal volume represents the inspiratory reserve volume, and expiration beyond the tidal volume represents the expiratory reserve volume. The amount of air left in the lungs after the greatest possible exhalation is called the residual volume. Gas exchange involves diffusion. At the lungs, oxygen gas diffuses from the alveolar spaces into the blood, and carbon dioxide gas diffuses from the blood into the alveolar space. At the tissues, oxygen gas diffuses from the blood into the cells, and carbon dioxide gas diffuses from the cells into the blood. Most oxygen is transported within red blood cells by the respiratory pigment hemoglobin; however, some oxygen is dissolved in the plasma. Hemoglobin can also transport carbon dioxide; however, most carbon dioxide is transported as bicarbonate ions and some is dissolved in the plasma. Upper and lower respiratory tract infections are discussed in this chapter as are the dangers associated with smoking cigarettes. Answers to several of the most often asked questions concerning smoking, tobacco, and health are provided.

Chapter Outline

- I. The Respiratory System
 - A. The Respiratory Tract
 - 1. The Nose
 - 2. The Pharynx
 - 3. The Larynx
 - 4. The Trachea
 - 5. The Bronchial Tree
 - B. The Lungs
 - 1. The Alveoli
- II. Mechanism of Breathing
 - A. Respiratory Volumes
 - B. Ventilation
 - 1. Inspiration
 - 2. Expiration
 - 3. Control of Ventilation
 - a. Nervous Input
 - b. Chemical Input
- III. Gas Exchange and Transport
 - A. External Respiration
 - B. Internal Respiration

- C. Gas Transport
 - 1. Oxygen Transport
 - 2. Carbon Dioxide Transport
- IV. Respiration and Health
 - A. Upper Respiratory Tract Infections
 - 1. Sinusitis
 - 2. Otitis Media
 - 3. Tonsillitis
 - 4. Laryngitis
 - B. Lower Respiratory Tract Disorders
 - 1. Lower Respiratory Infections
 - 2. Restrictive Pulmonary Disorders
 - 3. Obstructive Pulmonary Disorders
 - 4. Lung Cancer
- V. Effects of Aging
- VI. Homeostasis
 - A. Gas Exchange
 - B. Regulation of the Blood
 - C. Working with Other Systems

Suggested Student Activities

1. Using a model or chart, locate the organs of the respiratory tract and list the functions of each.
2. Discuss the use of the spirometer for measuring lung capacities and compare lung capacities of smokers to those of nonsmokers.
3. Compare respiration rates during exercise and relaxation.
4. Discuss factors which can affect the respiratory tract, including cigarette smoke.

Answers to Objective Questions

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| 1. larynx | 15. a. nasal cavity |
| 2. alveoli | b. nostril |
| 3. carbon dioxide | c. pharynx |
| 4. expanded | d. epiglottis |
| 5. diffusion | e. glottis |
| 6. enters | f. larynx |
| 7. enters | g. trachea |
| 8. bicarbonate | h. bronchus |
| 9. smoking cigarettes | i. lung |
| 10. bronchi | |
| 11. tidal volume | |
| 12. vital capacity | |
| 13. epiglottis | |
| 14. alveolus, capillary | |

Answers to Medical Terminology Reinforcement Exercise

1. eu/pnea - good/easy breathing
2. naso/pharyng/itis - inflammation of the nose and throat
3. trache/ostomy - opening in the windpipe—surgical creation of a mouth in the trachea for insertion of a tube to relieve upper airway obstruction
4. pneumono/melan/osis - abnormal condition of black lung

5. pleuro/peri/card/itis - inflammation of the pleura and pericardium (tissue surrounding the heart)
6. broncho/scopy - visualization of the bronchus with the use of an endoscope
7. dys/pnea - difficult or labored breathing
8. laryngo/spasm - spasmodic closure of the larynx (voice box)
9. hemo/thorax - blood in the chest (intrapleural space)
10. oto/rhino/laryngo/logy - study of ear, nose, and throat
11. hyp/ox/emia - conditions of low oxygen in the blood
12. pulmon/ectomy – removal of a lung
13. hyper/capnea – abnormally high blood carbon dioxide level
14. spiro/metry – measurement of respiratory volumes
15. thora/centesis – usage of instrument to drain thoracic cavity

Audiovisual Materials

1. Filmstrip - Respiration in the Human Body (HD-052X-NU)(Career Aids)
2. Transparency - Respiratory System (Career Aids)
3. Model - Lobule of the Lung (HS-2311)(Concept Media)
4. Model - Human Torso (B-13)(Concept Media)
5. Model - Respiratory Organs (649D)(Concept Media)