

Vocabulary Related to the Respiratory System

Terms marked with the ❖ symbol are pronounced on the Student Activity CD-ROM that accompanies this text.

KEY WORD PARTS

- ☐ **atel/o**
- ☐ **bronch/o, bronchi/o**
- ☐ **cyan/o**
- ☐ **-ectasis**
- ☐ **laryng/o**
- ☐ **ox/i, ox/o, ox/y**
- ☐ **pharyng/o**
- ☐ **phon/o**
- ☐ **pleur/o**
- ☐ **-pnea**
- ☐ **pneum/o, pneumon/o, pneu-**
- ☐ **pulm/o, pulmon/o**
- ☐ **tachy-**
- ☐ **thorac/o, -thorax**
- ☐ **trache/o**

KEY MEDICAL TERMS

- ☐ **anoxia** (ah-NOCK-see-ah)
- ☐ **anthracosis** (an-thrah-KOH-sis)
- ☐ **aphonia** (ah-FOH-nee-ah)
- ☐ **apnea** (AP-nee-ah or ap-NEE-ah) ❖
- ☐ **asbestosis** (ass-beh-STOH-sis)
- ☐ **asphyxia** (ass-FICK-see-ah)
- ☐ **asphyxiation** (ass-fick-see-AY-shun) ❖
- ☐ **asthma** (AZ-mah) ❖
- ☐ **atelectasis** (at-ee-LEK-tah-sis) ❖
- ☐ **bradypnea** (brad-ihp-NEE-ah or brad-ee-NEE-ah) ❖
- ☐ **bronchiectasis** (brong-kee-ECK-tah-sis) ❖
- ☐ **bronchoconstrictor** (brong-koh-kon-STRICK-tor)
- ☐ **bronchodilator** (brong-koh-dye-LAY-tor)
- ☐ **bronchopneumonia** (brong-koh-new-MOH-nee-ah) ❖
- ☐ **bronchorrhagia** (brong-koh-RAY-jee-ah) ❖
- ☐ **bronchorrhea** (brong-koh-REE-ah) ❖
- ☐ **bronchoscopy** (brong-KOS-koh-pee) ❖
- ☐ **Cheyne-Stokes respiration** (CHAYN-STOHKS) ❖
- ☐ **croup** (KROOP) ❖
- ☐ **cystic fibrosis** (SIS-tick figh-BROH-sis) ❖
- ☐ **diphtheria** (dif-THEE-ree-ah) ❖
- ☐ **dysphonia** (dis-FOH-nee-ah) ❖
- ☐ **dyspnea** (DISP-nee-ah) ❖
- ☐ **emphysema** (em-fih-SEE-mah) ❖
- ☐ **empyema** (em-pye-EE-mah) ❖
- ☐ **endotracheal intubation** (en-doh-TRAY-kee-al in-too-BAY-shun)
- ☐ **epiglottis** (ep-ih-GLOT-is)
- ☐ **epistaxis** (ep-ih-STACK-sis) ❖

- ☐ **hemoptysis** (hee-MOP-tih-sis) ❖
- ☐ **hemothorax** (hee-moh-THOH-racks) ❖
- ☐ **hyperpnea** (high-perp-NEE-ah) ❖
- ☐ **hyperventilation** (high-per-ven-tih-LAY-shun) ❖
- ☐ **hypopnea** (high-poh-NEE-ah) ❖
- ☐ **hypoxia** (high-POCK-see-ah) ❖
- ☐ **influenza** (in-flew-EN-zah) ❖
- ☐ **inhalation** (in-hah-LAY-shun)
- ☐ **laryngectomy** (lar-in-JECK-toh-mee) ❖
- ☐ **laryngitis** (lar-in-JIGH-tis) ❖
- ☐ **laryngoplasty** (lah-RING-goh-plas-tee) ❖
- ☐ **laryngoplegia** (lar-ing-goh-PLÉE-jee-ah) ❖
- ☐ **laryngoscopy** (lar-ing-GOS-koh-pee) ❖
- ☐ **laryngospasm** (lah-RING-goh-spazm) ❖
- ☐ **mediastinum** (mee-dee-as-TYE-num)
- ☐ **mycoplasma pneumonia** (my-koh-PLAZ-mah new-MOH-nee-ah) ❖
- ☐ **nasopharyngitis** (nay-zoh-far-in-JIGH-tis) ❖
- ☐ **otolaryngologist** (oh-toh-lar-in-GOL-oh-jist) ❖
- ☐ **otorhinolaryngologist** (oh-toh-rye-noh-lar-in-GOL-oh-jist) ❖
- ☐ **pertussis** (per-TUS-is) ❖
- ☐ **pharyngitis** (far-in-JIGH-tis)
- ☐ **pharyngoplasty** (fah-RING-goh-plas-tee)
- ☐ **pharyngorrhagia** (far-ing-goh-RAY-jee-ah) ❖
- ☐ **pharyngorrhea** (far-ing-goh-REE-ah) ❖
- ☐ **pleuralgia** (ploor-AL-jee-ah) ❖
- ☐ **pleurectomy** (ploor-ECK-toh-mee) ❖
- ☐ **pleurisy** (PLOOR-ih-see) ❖
- ☐ **pneumoconiosis** (new-moh-koh-nee-OH-sis) ❖
- ☐ ***Pneumocystis carinii* pneumonia** (new-moh-SIS-tis kah-RYE-nee-eye new-MOH-nee-ah) ❖
- ☐ **pneumectomy** (new-moh-NECK-toh-mee) ❖
- ☐ **pneumorrhagia** (new-moh-RAY-jee-ah) ❖
- ☐ **pneumothorax** (new-moh-THOR-racks) ❖
- ☐ **pulmonologist** (pull-mah-NOL-oh-jist) ❖
- ☐ **pyothorax** (pye-oh-THOH-racks) ❖
- ☐ **rhinorrhea** (rye-noh-REE-ah)
- ☐ **sinusitis** (sigh-nuh-SIGH-tis) ❖
- ☐ **sinusotomy** (sigh-nuhs-OT-oh-mee) ❖
- ☐ **spirometry** (spy-ROM-eh-tree) ❖
- ☐ **tachypnea** (tack-ihp-NEE-ah) ❖
- ☐ **thoracentesis** (thoh-rah-sen-TEE-sis) ❖
- ☐ **thoracostomy** (thoh-rah-KOS-toh-mee) ❖
- ☐ **thoracotomy** (thoh-rah-KOT-toh-mee) ❖
- ☐ **tracheitis** (tray-kee-EYE-tis) ❖
- ☐ **tracheoplasty** (TRAY-kee-oh-plas-tee) ❖
- ☐ **tracheostomy** (tray-kee-OS-toh-mee) ❖
- ☐ **tracheotomy** (tray-kee-OT-oh-mee) ❖
- ☐ **tuberculosis** (too-ber-kew-LOH-sis)

Objectives

Upon completion of this chapter, you should be able to:

1. Identify and describe the major structures and functions of the respiratory system.
2. Recognize, define, spell, and pronounce terms related to the pathology and diagnostic and treatment procedures of the respiratory system.

FUNCTIONS OF THE RESPIRATORY SYSTEM

The functions of the respiratory system are to

- Bring oxygen-rich air into the body for delivery to the blood cells.
- Expel waste products (carbon dioxide and water) that have been returned to the lungs by the blood.
- Produce the air flow through the larynx that makes speech possible.

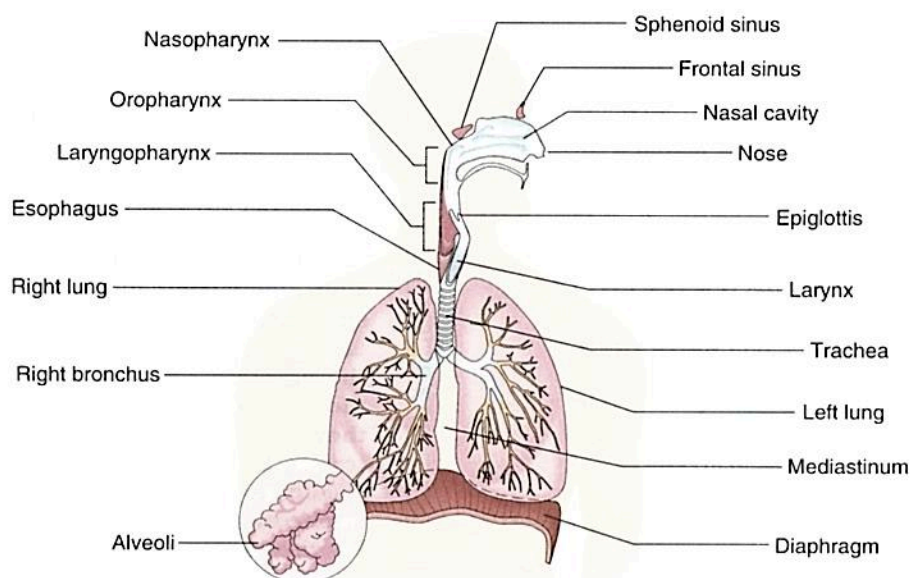
STRUCTURES OF THE RESPIRATORY SYSTEM

For descriptive purposes, the respiratory system is divided into upper and lower tracts (Figure 7.1).

- The **upper respiratory tract** consists of the nose, mouth, pharynx, epiglottis, larynx, and trachea (Figure 7.2).
- The **lower respiratory tract** consists of the bronchial tree and lungs. These structures are protected by the thoracic cavity.

THE NOSE

- Air enters the body through the nose and passes through the **nasal cavity**.
- The **nasal septum** (NAY-zal SEP-tum) is a wall of cartilage that divides the nose into two equal sections.
- **Mucous membrane** (MYOU-kus) is the specialized form of epithelial tissue that lines the nose and respiratory system.
- **Mucus** (MYOU-kus), which is secreted by the mucous membranes, helps to moisten, warm, and filter the air as it enters the nose. *Notice the different spellings:* Mucous is the name of the tissue; mucus is the secretion that flows from the tissue.
- **Cilia** (SIL-ee-ah), the thin hairs located just inside the nostrils, filter incoming air to remove debris.
- The **olfactory receptors** (ol-FACK-toh-ree), the receptors for the sense of smell, are nerve endings located in the mucous membrane in the upper part of the nasal cavity.



Respiratory System

FIGURE 7.1 Structures of the respiratory system.

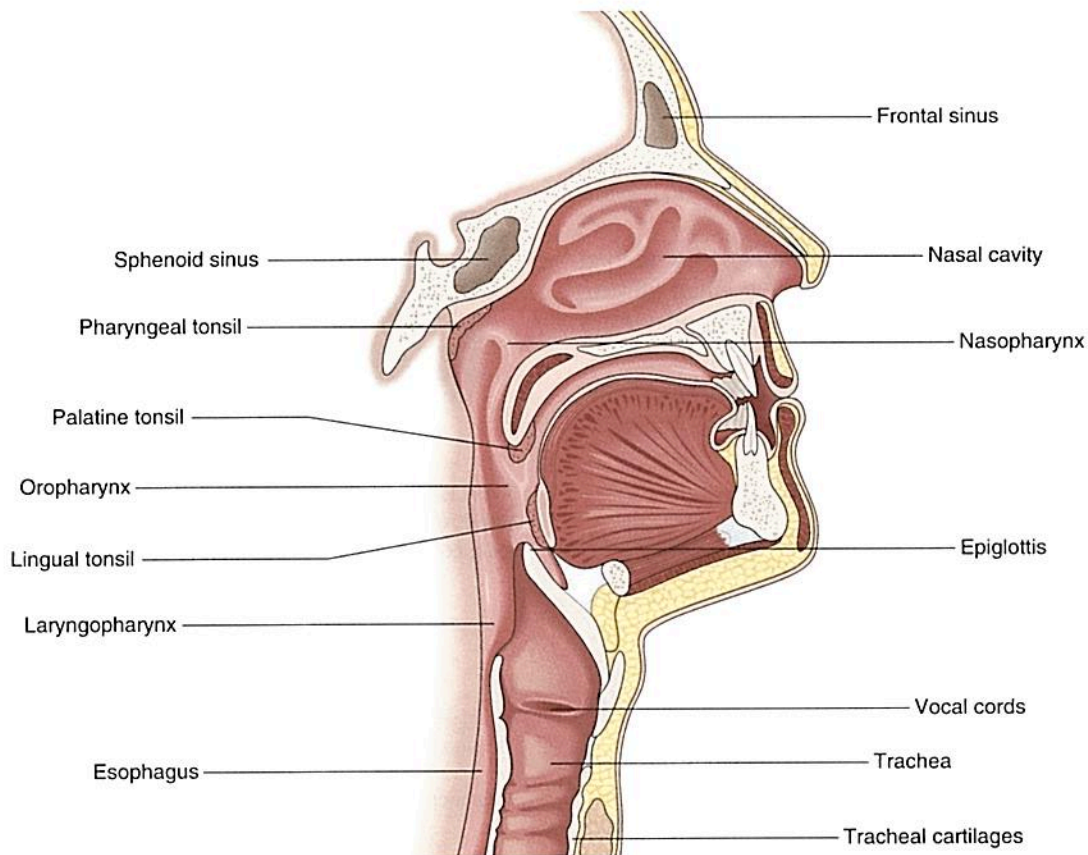


FIGURE 7.2 Structures of the upper respiratory tract.

THE TONSILS

- The **tonsils**, which have an important function in protecting the body from invading organisms, form a protective circle around the entrance to the respiratory system. Tonsils, which are a type of lymphatic tissue, are discussed in Chapter 6.

THE SINUSES

- A **sinus** is an air-filled cavity within a bone that is lined with mucous membrane.

- The functions of sinuses are (1) to make the bones of the skull lighter, (2) to help produce sound by giving resonance to the voice, and (3) to produce mucus that drains into the nasal cavity.
- The **paranasal sinuses** are located in the bones of the skull (**para-** means near, **nas** means nose, and **-al** means pertaining to). Short ducts connect these sinuses to the nasal cavity.
- The sinuses are named for the bones in which they are located. The paranasal sinuses are summarized in Table 7.1.

Table 7.1

PARANASAL SINUSES

Maxillary sinuses (**MACK-sih-ler-ee**), located in the maxillary bones, are the largest of the paranasal sinuses.

The **ethmoid sinuses** (**ETH-moid**), located in the ethmoid bones, are irregularly shaped air cells that are separated from the orbital (eye) cavity only by a thin layer of bone.

Frontal sinuses are located in the frontal bone just above the eyebrows.

The **sphenoid sinuses** (**SFEE-noid**), located in the sphenoid bone, are close to the optic nerves. An infection here can damage vision.



THE PHARYNX

- After passing through the nasal cavity, the air reaches the **pharynx** (FAR-inks), which is commonly known as the **throat** (see Figure 7.2). The pharynx has three divisions:
- The **nasopharynx** (nay-zoh-FAR-inks), the first division, is posterior to the nasal cavity and continues downward to behind the mouth.
- The **oropharynx** (oh-roh-FAR-inks), the second division, is the portion that is visible when looking into the mouth (see Figure 8.2). The oropharynx is shared by the respiratory and digestive systems.
- The **laryngopharynx** (lah-ring-goh-FAR-inks), the third division, continues downward to the openings of the esophagus and trachea.

Protective Swallowing Mechanisms

The respiratory and digestive systems share part of the pharynx. During swallowing, there is the risk of a blocked airway or pneumonia caused by something entering the lungs instead of traveling into the esophagus.

- Two protective mechanisms act automatically during swallowing to ensure that *only* air goes into the lungs.
- During swallowing, the soft palate, which is the muscular posterior portion of the roof of the mouth, moves up and backward to close off the nasopharynx. This movement prevents food from going up into the nose. (Structures of the mouth are discussed further in Chapter 8.)
- At the same time, the **epiglottis** (ep-ih-GLOT-is), which is a lidlike structure located at the base of the tongue, swings downward and closes off the laryngopharynx so food does not enter the trachea and the lungs.

THE LARYNX

- The **larynx** (LAR-inks), also known as the **voice box**, is a triangular chamber located between the pharynx and the trachea (Figure 7.3).
- The larynx is protected and held open by a series of nine separate cartilages. The **thyroid cartilage** is the largest and its prominent projection is commonly known as the **Adam's apple**.
- The larynx contains the **vocal cords**. During breathing, the cords are separated to let air pass. During speech, they are together, and sound is produced as air is expelled from the lungs, causing the cords to vibrate against each other.

THE TRACHEA

- Air passes from the larynx into the **trachea** (TRAY-kee-ah), which is commonly known as the **wind-pipe** (Figure 7.4).

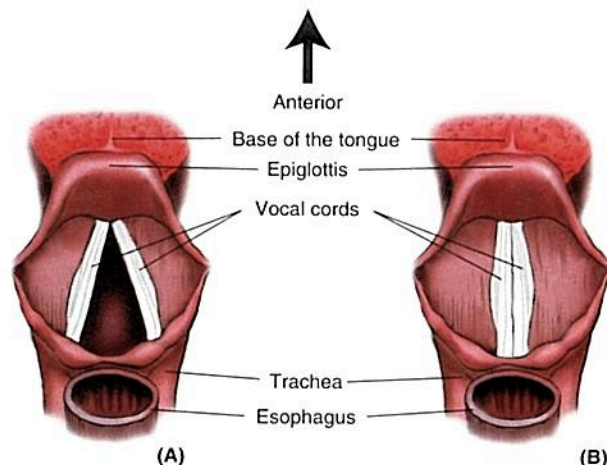


FIGURE 7.3 View of the larynx and vocal cords from above. (A) The vocal cords are open during breathing. (B) The vocal cords vibrate together during speech.

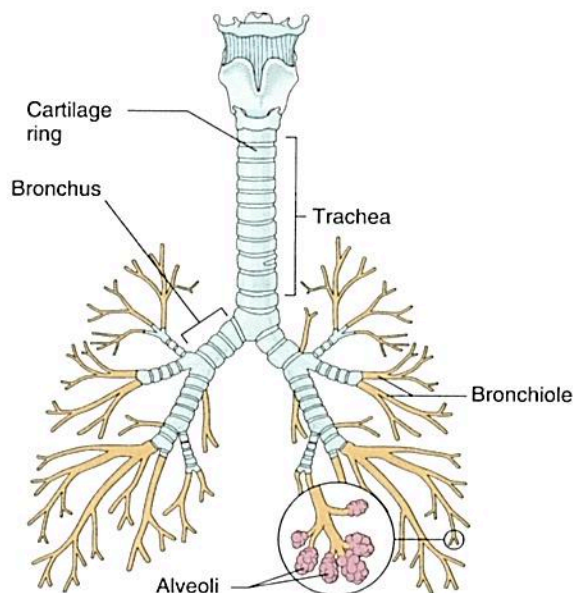


FIGURE 7.4 The trachea, bronchial tree, and alveoli.

- The trachea extends from the neck into the chest, directly in front of the esophagus and is held open by a series of C-shaped cartilage rings. The wall between these rings is elastic, enabling the trachea to adjust to different body positions.

THE BRONCHIAL TREE

- The trachea divides into two branches called **bronchi** (BRONG-kye). A branch goes into each lung (singular, **bronchus**).
- Within the lung, the bronchus divides and subdivides into increasingly smaller bronchi. **Bronchioles** (BRONG-kee-ohlz) are the smallest branches of the bronchi.

- Because of the similarity of these branching structures to a tree, this is referred to as the **bronchial tree** (see Figure 7.4).

THE ALVEOLI

- **Alveoli** (al-VEE-oh-lye), also known as **air sacs**, are the very small grapelike clusters found at the end of each bronchiole (see Figures 7.1 and 7.4) (singular, **alveolus**).
- The thin flexible walls of the alveoli are surrounded by a network of microscopic pulmonary capillaries.
- During respiration, the gas exchange between the alveolar air and the pulmonary capillary blood occurs through the walls of the alveoli.

THE LUNGS

- A **lobe** is a division of the lungs (Figure 7.5).
- The **right lung** has three lobes: the superior, middle, and inferior.
- The **left lung** has two lobes: the superior and inferior.

THE MEDIASTINUM

- The **mediastinum** (mee-dee-as-TYE-num), also known as the **interpleural space**, is located between the lungs (see Figure 7.1).
- This space contains the thoracic viscera including the heart, aorta, esophagus, trachea, bronchial tubes, and thymus gland.

THE PLEURA

- The **pleura** (PLOOR-ah) is a multilayered membrane that surrounds each lung with its blood vessels and nerves (plural, **pleurae**).
- The **parietal pleura** (pah-RYE-eh-tal PLOOR-ah) is the outer layer of the pleura. It lines the thoracic cavity and forms the sac containing each lung.
- The **visceral pleura** (VIS-er-al PLOOR-ah) is the inner layer of pleura. It closely surrounds the lung tissue.
- The **pleural space**, also known as the **pleural cavity**, is the airtight space between the folds of the pleural membranes. It contains a watery lubricating fluid that prevents friction when the membranes rub together during respiration.

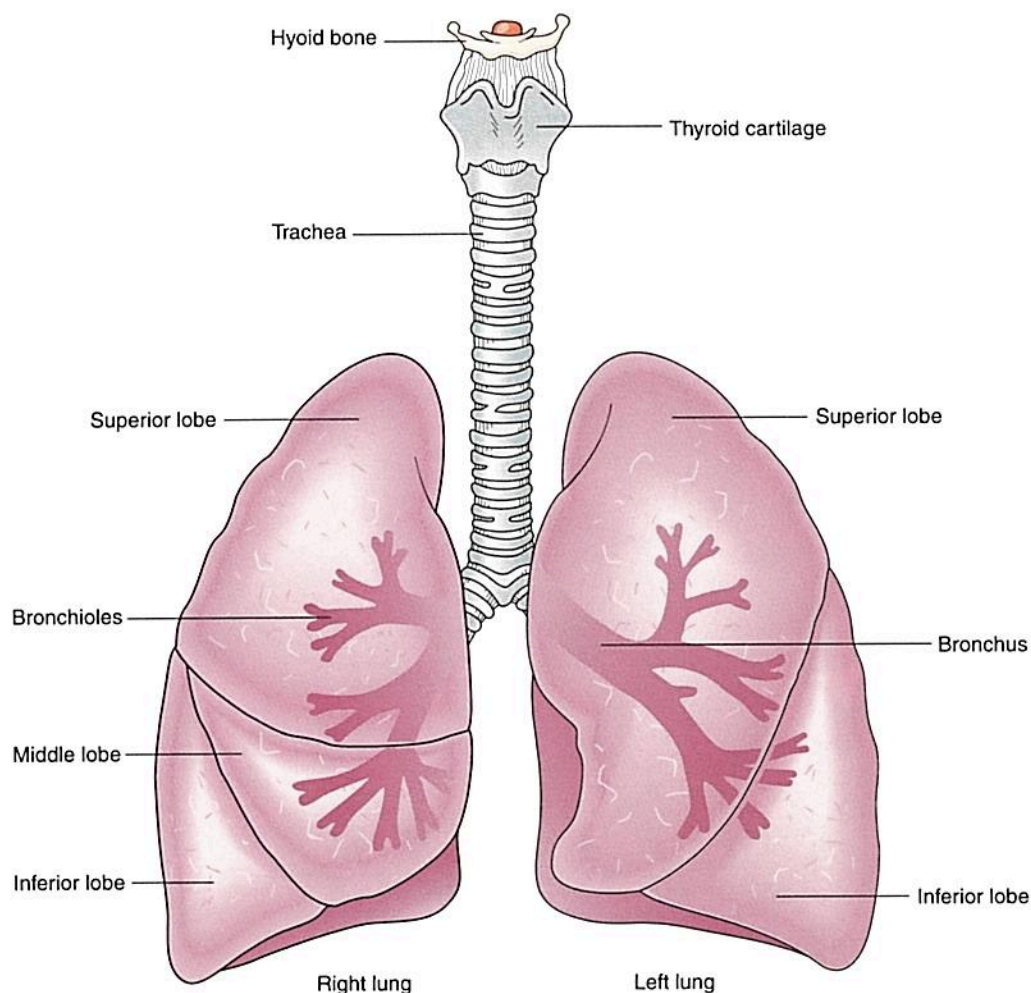


FIGURE 7.5 External view of the lungs. Note the three lobes of the right lung and the two lobes of the left lung.



THE DIAPHRAGM

- The **diaphragm** (DYE-ah-fram) is the muscle that separates the thoracic cavity from the abdomen (see Figures 7.1 and 7.6). It is the contraction and relaxation of this muscle that makes breathing possible.
- The **phrenic nerve** (FREN-ick) stimulates the diaphragm and causes it to contract (**phren** means diaphragm or mind, and **-ic** means pertaining to).

RESPIRATION

Respiration is the exchange of gases that are essential to life. This occurs in the lungs as external respiration and on a cellular level as internal respiration.

EXTERNAL RESPIRATION

- **Breathing** is the act of bringing air into and out of the lungs.
- **Inhalation** (in-hah-LAY-shun), also known as **inhaling**, is the act of taking in air as the diaphragm contracts and pulls downward. This action causes the thoracic cavity to expand. This expansion produces a vacuum within the thoracic cavity that draws air into the lungs (Figure 7.6, left photo).
- **Exhalation** (ecks-hah-LAY-shun) is the act of breathing out. As the diaphragm relaxes, it moves upward, causing the thoracic cavity to become narrower. This action forces air out of the lungs (Figure 7.6, right photo).

The Exchange of Gases within the Lungs

As air moves in and out, there is an **exchange of gases** within the lungs (Figure 7.7A).

- As air is **inhaled** into the alveoli, oxygen (O_2) immediately passes into the surrounding capillaries and is carried by the erythrocytes to all body cells.
- At the same time, the waste product carbon dioxide (CO_2) passes from the capillaries into the airspaces of the lungs to be **exhaled**.

INTERNAL RESPIRATION

- Internal respiration is the exchange of gases within the cells of all the body organs and tissues (Figure 7.7B).
- In this process, oxygen passes from the bloodstream into the tissue cells. At the same time, carbon dioxide passes from the tissue cells into the bloodstream.

MEDICAL SPECIALTIES RELATED TO THE RESPIRATORY SYSTEM

- An **otolaryngologist** (oh-toh-lar-in-GOL-oh-jist), also known as an **otorhinolaryngologist** (oh-toh-rye-noh-lar-in-GOL-oh-jist), specializes in diagnosing and treating diseases and disorders of the ears, nose, and throat.
- A **pulmonologist** (pull-mah-NOL-oh-jist) is a physician who specializes in diagnosing and treating diseases and disorders of the lungs and associated tissues (**pulmon** means lung and **-ologist** means specialist).

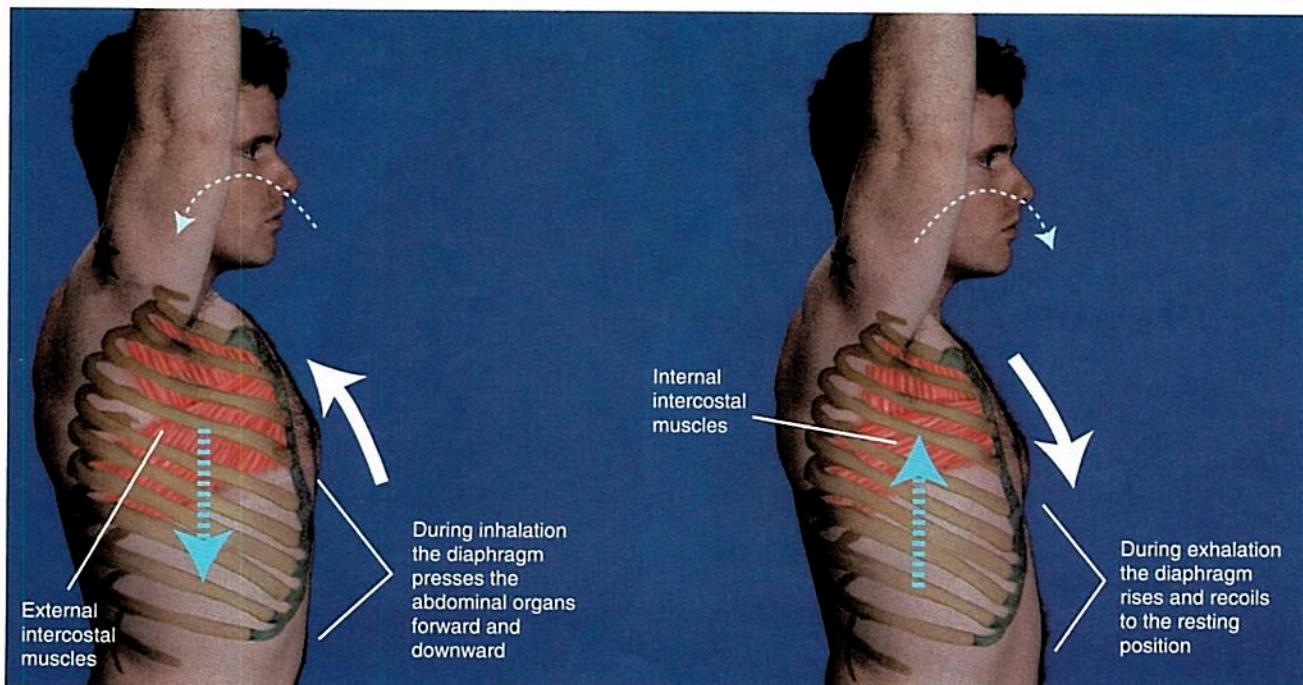


FIGURE 7.6 Movement of the diaphragm and thoracic cavity during (left) inhalation and (right) exhalation.

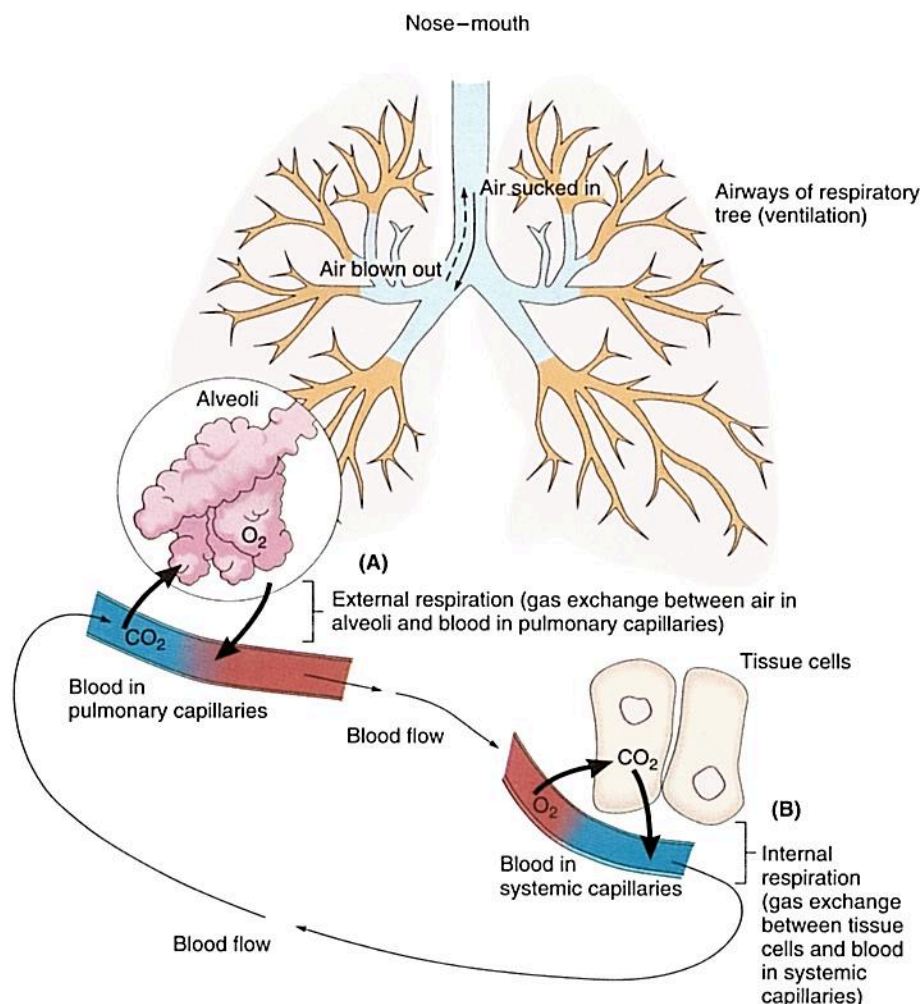


FIGURE 7.7 External and internal respiration compared. (A) External respiration, with the exchange of gases between the lungs and capillaries. (B) Internal respiration, with the exchange between the blood and tissues.

PATHOLOGY OF THE RESPIRATORY SYSTEM

CHRONIC OBSTRUCTIVE PULMONARY DISEASES

- **Chronic obstructive pulmonary disease (COPD)** is a general term used to describe a group of respiratory conditions characterized by chronic airflow limitations.
- **Asthma (AZ-mah)** is a chronic allergic disorder characterized by episodes of severe breathing difficulty, coughing, and wheezing (Figure 7.8). Breathing difficulty during an asthma attack is caused by several factors: (1) swelling and inflammation of the lining of the airways, (2) the production of thick mucus, and (3) tightening of the muscles that surround the airways. (For treatment, see **bronchodilator**, under Medications.)
- **Bronchiectasis (brong-kee-ECK-tah-sis)** is chronic dilation (enlargement) of bronchi or bronchioles resulting from an earlier lung infection that was not cured (**bronchi** means bronchi and **-ectasis** means enlargement) (Figure 7.9).
- **Emphysema (em-fih-SEE-mah)** is the progressive loss of lung function due to a decrease in the total number of alveoli, the enlargement of the remaining alveoli, and then the progressive destruction of their walls (see Figure 7.10A on page 131). As the alveoli are destroyed, breathing becomes increasingly rapid, shallow, and difficult. In an effort to compensate for the loss of capacity, the lungs expand and the chest assumes an enlarged barrel shape (Figure 7.10B).
- **Smoker's respiratory syndrome (SRS)** is a group of symptoms seen in smokers. These chronic conditions include (1) a cough, (2) wheezing, (3) vocal hoarseness, (4) pharyngitis (sore throat), (5) difficult breathing, and (6) a susceptibility to respiratory infections.

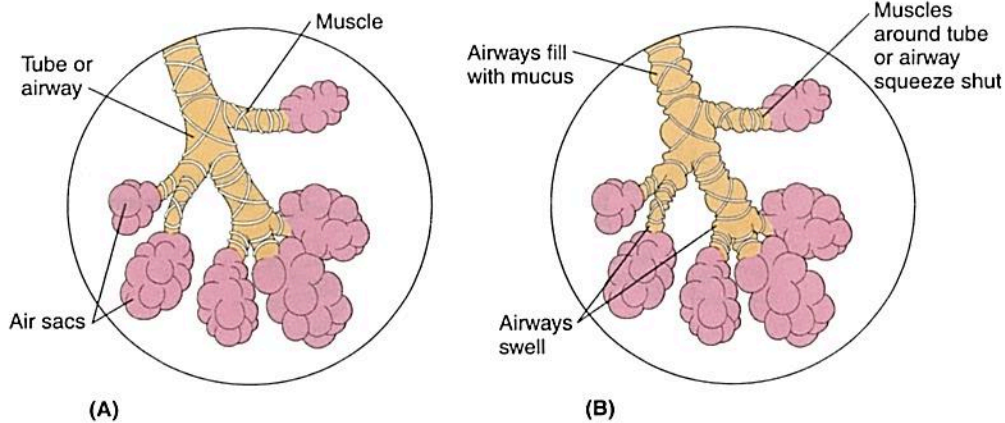


FIGURE 7.8 Changes in the airways during an asthma episode. (A) Before the episode, the muscles are relaxed and the airways are open. (B) During the episode, the muscles tighten and the airways fill with mucus.

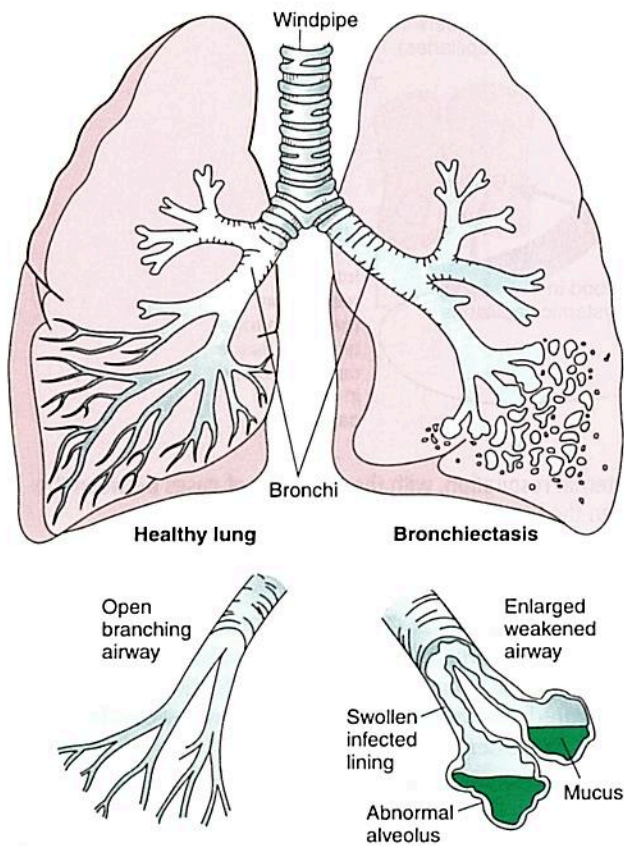


FIGURE 7.9 In bronchiectasis, the bronchi widen and lose their elasticity, thereby allowing mucus to accumulate in the alveoli.

UPPER RESPIRATORY DISEASES

- **Allergic rhinitis** (rye-NIGH-tis), commonly referred to as an **allergy**, is an allergic reaction to airborne allergens that causes an increased flow of mucus (**rhin** means nose and **-itis** means inflammation).

- **Croup (KROOP)** is an acute respiratory syndrome in children and infants characterized by obstruction of the larynx, hoarseness, and a barking cough.
- **Diphtheria** (dif-THEE-ree-ah) is an acute infectious disease of the throat and upper respiratory tract caused by the presence of diphtheria bacteria. Diphtheria can be prevented through immunization.
- **Epistaxis** (ep-ih-STACK-sis), also known as a **nose-bleed**, is bleeding from the nose, usually caused by an injury, excessive use of blood thinners, or bleeding disorders.
- **Influenza** (in-flew-EN-zah), also known as **flu**, is an acute, highly contagious viral respiratory infection, spread by respiratory droplets, that occurs most commonly during the colder months. Some strains of influenza can be prevented by annual immunization.
- **Pertussis** (per-TUS-is), also known as **whooping cough**, is a contagious bacterial infection of the upper respiratory tract that is characterized by a paroxysmal cough. **Paroxysmal** (par-ock-SIZ-mal) means sudden or spasm like. Pertussis can be prevented through immunization.
- **Rhinorrhea** (rye-noh-REE-ah), also known as a **runny nose**, is an excessive flow of mucus from the nose (**rhin/o** means nose and **-rrhea** means abnormal flow).
- **Sinusitis** (sigh-nuh-SIGH-tis) is an inflammation of the sinuses (**sinus** means sinus and **-itis** means inflammation).
- **Upper respiratory infection (URI)** and **acute nasopharyngitis** (nay-zoh-far-in-JIGH-tis) are among the terms used to describe the **common cold**.

PHARYNX AND LARYNX

- **Pharyngitis** (far-in-JIGH-tis), also known as a **sore throat**, is an inflammation of the pharynx (**pharyng** means pharynx and **-itis** means inflammation).

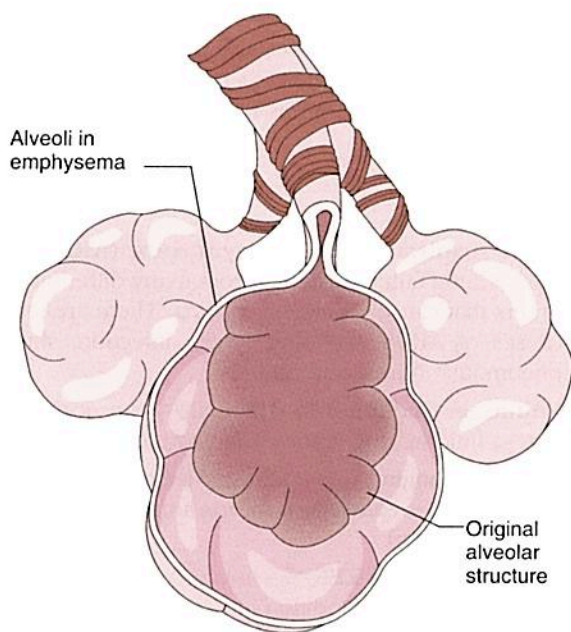


FIGURE 7.10 Emphysema. (A) Changes in the alveoli. (B) Lateral x-ray showing lung enlargement and abnormal barrel chest in emphysema.

- **Pharyngorrhagia** (far-ing-goh-RAY-jee-ah) is bleeding from the pharynx (**pharyng/o** means pharynx and **-rrhagia** means bleeding).
- **Pharyngorrhea** (far-ing-goh-REE-ah) is a discharge of mucus from the pharynx (**pharyng/o** means pharynx and **-rrhea** means abnormal discharge).
- **Laryngoplegia** (lar-ing-goh-PLÉE-jee-ah) is paralysis of the larynx (**laryng/o** means larynx and **-plegia** means paralysis).
- A **laryngospasm** (lah-RING-goh-spazm) is a sudden spasmodic closure of the larynx (**laryng/o** means larynx and **-spasm** means a sudden involuntary contraction).
- **Tracheorrhagia** (tray-kee-oh-RAY-jee-ah) is bleeding from the trachea (**trache/o** means trachea and **-rrhagia** means bleeding).
- **Bronchitis** (brong-KYE-tis) is an inflammation of the bronchial walls (**bronch** means bronchus and **-itis** means inflammation). Bronchitis is usually caused by an infection. However, it also may be caused by irritants such as smoking.
- **Bronchorrhagia** (brong-koh-RAY-jee-ah) is bleeding from the bronchi (**bronch/o** means bronchus and **-rrhagia** means bleeding).
- **Bronchorrhea** (brong-koh-REE-ah) means an excessive discharge of mucus from the bronchi (**bronch/o** means bronchus and **-rrhea** means abnormal flow).

Voice Disorders

- **Aphonia** (ah-FOH-nee-ah) is the loss of the ability to produce normal speech sounds (**a-** means without, **phon** means voice or sound, and **-ia** means abnormal condition).
- **Dysphonia** (dis-FOH-nee-ah) is any voice impairment including hoarseness, weakness, or loss of voice (**dys-** means bad, **phon** means voice or sound, and **-ia** means abnormal condition).
- **Laryngitis** (lar-in-JIGH-tis) is an inflammation of the larynx (**laryng** means larynx and **-itis** means inflammation). This term is commonly used to describe voice loss caused by the inflammation.

TRACHEA AND BRONCHI

- **Tracheitis** (tray-kee-EYE-tis) is an inflammation of the trachea (**trache** means trachea and **-itis** means inflammation).

PLEURAL CAVITY

- **Pleurisy** (PLOOR-ih-see) is an inflammation of the visceral and parietal pleura in the thoracic cavity.
- **Pleuralgia** (ploor-AL-jee-ah) is pain in the pleura or in the side (**pleur** means pleura and **-algia** means pain).
- **Pneumothorax** (new-moh-THOR-racks) is an accumulation of air or gas in the pleural space causing the lung to collapse (**pneum/o** means lung or air, and **-thorax** means chest). This may have an external cause such as a stab wound that perforates the chest wall. It also may be caused internally by a perforation in the pleura surrounding the lung that allowed air to leak into the pleural space (Figure 7.11).

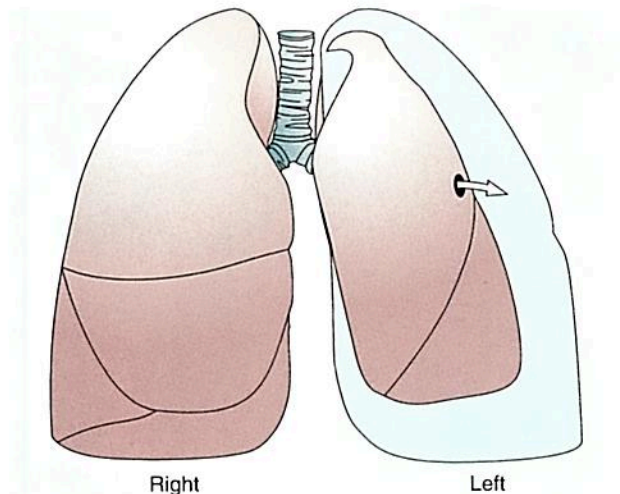


FIGURE 7.11 Pneumothorax is an accumulation of air or gas in the pleural space that causes the lung to collapse. In the left lung, a perforation in the pleura allowed air to escape into the pleural space.

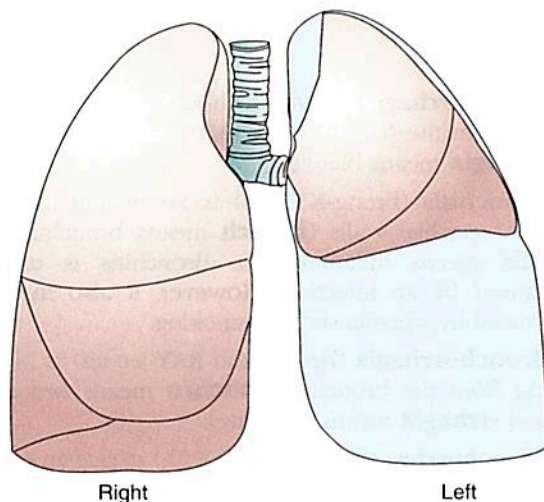


FIGURE 7.12 In pleural effusion, fluid in the pleural cavity prevents the lung from fully expanding.

- **Pleural effusion** (eh-FEW-zhun) is the abnormal escape of fluid into the pleural cavity that prevents the lung from fully expanding. (*Effusion* is the escape of fluid from blood or lymphatic vessels into the tissues or a cavity.) (Figure 7.12).
- **Empyema** (em-pye-EE-mah), also known as **pyothorax** (pye-oh-THOH-racks), is an accumulation of pus in the pleural cavity. This is usually the result of a primary infection of the lungs. (Empyema is also used to describe pus in other body cavities.)
- **Hemothorax** (hee-moh-THOH-racks) is an accumulation of blood in the pleural cavity (**hem/o** means blood and **-thorax** means chest).

- **Hemoptysis** (hee-MOP-tih-sis) is spitting of blood or blood-stained sputum derived from the lungs or bronchial tubes as the result of a pulmonary or bronchial hemorrhage (**hem/o** means blood and **-ptysis** means spitting).

LUNGS

- **Acute respiratory distress syndrome (ARDS)** is a type of lung failure resulting from many different disorders that cause pulmonary edema. There are many causes of ARDS including severe infection, shock, pneumonia, burns, and injuries.
- **Pulmonary edema** (eh-DEE-mah) is an accumulation of fluid in lung tissues. (*Edema* means swelling.)
- **Pneumorrhagia** (new-moh-RAY-jee-ah) is bleeding from the lungs (**pneum/o** means lungs and **-rrhagia** means bleeding).
- **Atelectasis** (at-ee-LEK-tah-sis), also known as a **collapsed lung**, is a condition in which the lung fails to expand because air cannot pass beyond the bronchioles that are blocked by secretions (**atel** means incomplete and **-ectasis** means stretching) (Figure 7.13).

Tuberculosis

- **Tuberculosis** (too-ber-kew-LOH-sis) (TB) is an infectious disease caused by *Mycobacterium tuberculosis*. TB usually attacks the lungs. However, it may also affect other parts of the body. A healthy individual may carry TB but not get the disease. TB most commonly occurs when the immune system is weakened by another condition such as infection with human immunodeficiency virus (HIV).

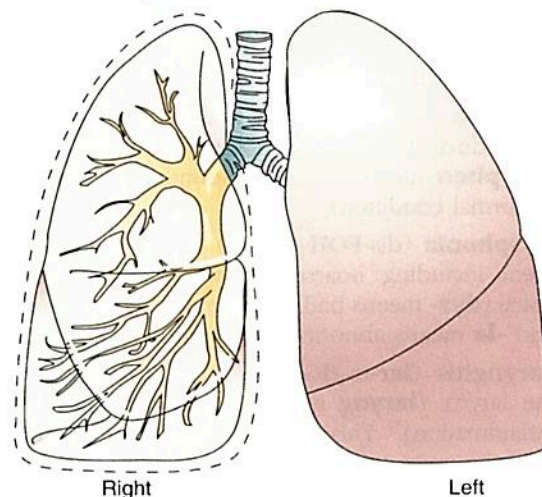


FIGURE 7.13 In atelectasis, as shown here in the right lung, the lung cannot expand because blockage in the bronchioles does not allow air to pass into the lung.

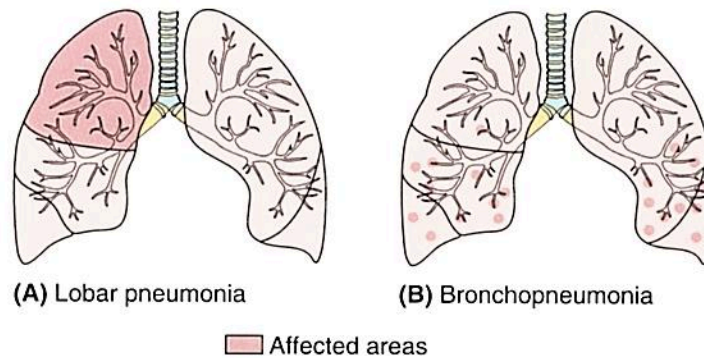


FIGURE 7.14 Types of pneumonia. (A) Lobar pneumonia affects one or more lobes of a lung. (B) Bronchopneumonia affects the bronchioles. The affected area of each lung is shown in darker pink.

- **Multidrug-resistant tuberculosis (MDR-TB)** is a dangerous form of tuberculosis because the germs have become resistant to the effect of most TB drugs. Resistance may occur if a TB infection has not been adequately treated. MDR-TB can be spread to others just as regular TB is.

Pneumonia

- **Pneumonia** (new-MOH-nee-ah) is an inflammation of the lungs in which the air sacs fill with pus and other liquid (**pneumon** means lung or air and **-ia** means abnormal condition). This fluid is known as an **exudate** (ECKS-you-dayt), which means accumulated fluid in a cavity that has penetrated through vessel walls into the adjoining tissue.
- The **main causes of pneumonia** are bacteria, viruses, fungi, or inhaled substances such as chemical irritants or vomit.
- **Bacterial pneumonia**, which is commonly caused by *Streptococcus pneumoniae*, is the only form of pneumonia that can be prevented through vaccination.
- **Viral pneumonia** accounts for approximately half of all pneumonias and may be complicated by an invasion of bacteria with all of the symptoms of bacterial pneumonia.
- **Lobar pneumonia** affects one or more lobes of a lung (Figure 7.14A).
- **Bronchopneumonia** (brong-koh-new-MOH-nee-ah) is a form of pneumonia that begins in the bronchioles (Figure 7.14B).
- **Double pneumonia** involves both lungs.
- **Aspiration pneumonia** may occur when a foreign substance, such as vomit, is inhaled into the lungs. (As used here, *aspiration* (ass-pih-RAY-shun) means inhaling or drawing a foreign substance, such as food, into the upper respiratory tract. Aspiration also means withdrawal by suction of fluids or gases from a body cavity.)
- **Mycoplasma pneumonia** (my-koh-PLAZ-mah new-MOH-nee-ah), also known as **mycoplasmal** or **walking pneumonia**, is a milder but longer lasting form of the disease caused by the fungus *Mycoplasma pneumoniae*.
- **Pneumocystis carinii pneumonia** (new-moh-SIS-tis kah-RYE-nee-eye new-MOH-nee-ah) (PCP) is caused by an infection with the parasite *Pneumocystis carinii*. PCP is an opportunistic infection that frequently occurs when the immune system is weakened by an HIV infection.

Environmental and Occupational Lung Diseases

- **Pneumoconiosis** (new-moh-koh-nee-OH-sis) is an abnormal condition caused by dust in the lungs that usually develops after years of environmental or occupational contact. This causes cell death and fibrosis (hardening) of the lung tissues. These disorders are named for the causative agents:
 - **Anthracosis** (an-thrah-KOH-sis), also known as **black lung disease**, is caused by coal dust in the lungs (**anthrac** means coal dust and **-osis** means condition).
 - **Asbestosis** (ass-beh-STOH-sis) is caused by asbestos particles in the lungs and is found in workers from the shipbuilding and construction trades.
 - **Byssinosis** (biss-ih-NOH-sis), also known as **brown lung disease**, is caused by cotton, flax, or hemp dust in the lungs.
 - **Silicosis** (sill-ih-KOH-sis), also known as **grinder's disease**, is caused by silica dust or glass in the lungs.

Pulmonary Fibrosis

- **Pulmonary fibrosis** (figh-BROH-sis) is the formation of scar tissue that replaces the pulmonary alveolar walls. (*Fibrosis* means the abnormal formation of fibrous tissue.) This condition may be caused by autoimmune disorders, infections, dust, gases, toxins, and some drugs. This destruction of lung tissue results in decreased lung capacity and increased difficulty in breathing.

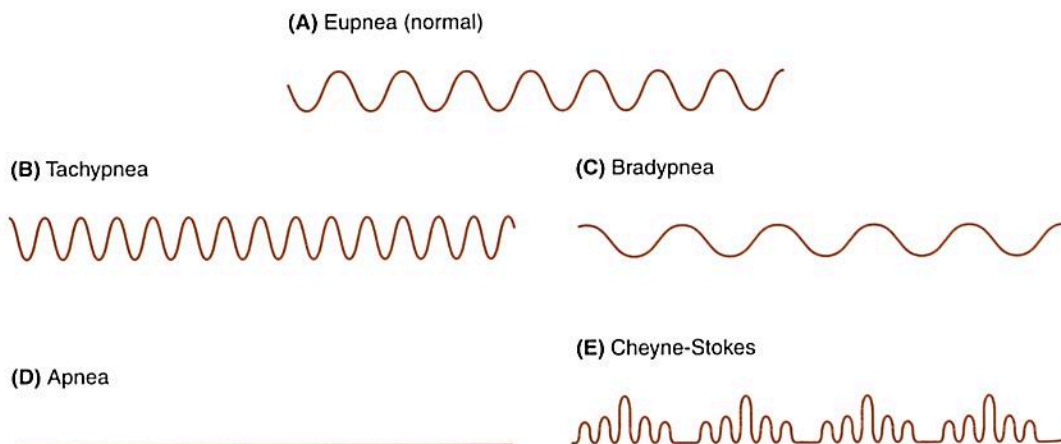


FIGURE 7.15 Respiratory patterns. (A) Eupnea, also known as normal breathing. (B) Tachypnea, also known as abnormally rapid breathing. (C) Bradypnea, also known as abnormally slow breathing. (D) Apnea, is the absence of breathing. (E) Cheyne-Stokes is an alternating series of abnormal patterns.

- **Idiopathic pulmonary fibrosis (IPF)** is a type of pulmonary fibrosis for which a cause cannot be identified. (*Idiopathic* [id-ee-oh-PATH-ick] means without known cause.)

Cystic Fibrosis

- **Cystic fibrosis (SIS-tick figh-BROH-sis) (CF)** is a genetic disorder in which the lungs are clogged with large quantities of abnormally thick mucus. Antibiotics are administered to control lung infections and daily physical therapy, known as **postural drainage**, is performed to remove excess mucus from the lungs.
- In CF, the digestive system is also impaired by thick glue-like mucus that interferes with digestive juices. Digestive enzymes are administered to aid the digestive system.

BREATHING DISORDERS

Eupnea (youp-NEE-ah) is easy or normal breathing (**eu-** means good and **-pnea** means breathing). This is the baseline for judging some breathing disorders (Figure 7.15A).

- **Tachypnea** (tack-ihp-NEE-ah) is an abnormally rapid rate of respiration usually of more than 20 breaths per minute (**tachy-** means rapid and **-pnea** means breathing). See Figure 7.15B.
- **Bradypnea** (brad-ihp-NEE-ah or brad-ee-NEE-ah) is an abnormally slow rate of respiration usually of less than 10 breaths per minute (**brady-** means slow and **-pnea** means breathing). See Figure 7.15C.
- **Apnea** (AP-nee-ah or ap-NEE-ah) is the absence of spontaneous respiration (**a-** means without and **-pnea** means breathing). See Figure 7.15D.
- **Sleep apnea syndromes (SAS)** are a group of potentially deadly disorders in which breathing repeatedly stops during sleep for long enough periods to cause a measurable decrease in blood oxygen levels.

- In **Cheyne-Stokes respiration (CHAYN-STOHKS) (CSR)** there is a pattern of alternating periods of hyperpnea (rapid breathing), hypopnea (slow breathing), and apnea (the absence of breathing). See Figure 7.15E.
- **Dyspnea** (DISP-nee-ah), also known as **shortness of breath**, is difficult or labored breathing (**dys-** means painful and **-pnea** means breathing).
- **Hyperpnea** (high-perp-NEE-ah) is an abnormal increase in the depth and rate of the respiratory movements (**hyper-** means excessive and **-pnea** means breathing).
- **Hypopnea** (high-poh-NEE-ah) is shallow or slow respiration (**hypo** means decreased and **pnea** means breathing).
- **Hyperventilation** (high-per-ven-tih-LAY-shun) is abnormally rapid deep breathing, resulting in decreased levels of carbon dioxide at the cellular level.

LACK OF OXYGEN

- In an **airway obstruction**, food or a foreign object blocks the airway and prevents air from entering or leaving the lungs. This is a life-threatening emergency requiring immediate action usually by the abdominal (Heimlich) maneuver.
- **Anoxia** (ah-NOCK-see-ah) is the absence or almost complete absence of oxygen from inspired gases, arterial blood, or tissues (**an-** means without, **ox** means oxygen, and **-ia** means abnormal condition). If anoxia continues for more than four to six minutes, irreversible brain damage may occur.
- **Asphyxia** (ass-FICK-see-ah) describes the pathologic changes caused by a lack of oxygen in air that is breathed in. This produces anoxia and hypoxia.
- **Asphyxiation** (ass-fick-see-AY-shun), also known as **suffocation**, is any interruption of breathing resulting in the loss of consciousness or death.

Asphyxiation may be caused by an airway obstruction, drowning, smothering, choking, or inhaling gases such as carbon monoxide.

- **Cyanosis** (sigh-ah-NOH-sis) is a bluish discoloration of the skin caused by a lack of adequate oxygen (**cyan** means blue and **-osis** means abnormal condition).
- **Hypoxia** (high-POCK-see-ah) is the condition of having subnormal oxygen levels in the cells that is less severe than anoxia (**hypo-** means deficient, **ox** means oxygen, and **-ia** means abnormal condition).
- **Respiratory failure** is a condition in which the level of oxygen in the blood becomes dangerously low or the level of carbon dioxide becomes dangerously high.

SUDDEN INFANT DEATH SYNDROME

- **Sudden infant death syndrome**, also known as **SIDS** and **crib death**, is the sudden and unexplainable death of an apparently healthy infant between the ages of two weeks and one year that typically occurs while the infant is sleeping. This happens more often among babies who sleep on their stomach. For this reason, it is recommended that infants be put down to sleep on the back or side.

DIAGNOSTIC PROCEDURES OF THE RESPIRATORY SYSTEM

- **Respiratory rate (RR)** is an important diagnostic sign. The RR is counted as the number of respirations per minute. A single **respiration** (breath) consists of one inhalation and one exhalation. The normal range for adults is 15 to 20 respirations per minute.
- **Pulmonary function tests (PFTs)** are a group of tests used to measure the capacity of the lungs to hold air as well as their ability to move air in and out and to exchange oxygen and carbon dioxide.
- **Phlegm (FLEM)** is the thick mucus secreted by the tissues lining the respiratory passages. When phlegm is ejected through the mouth, it is called **sputum** (SPYOU-tum). Sputum may be used for diagnostic purposes.
- **Bronchoscopy** (brong-KOS-koh-pee) is the visual examination of the bronchi using a **bronchoscope** (**bronch/o** means bronchus and **-scopy** means direct visual examination). This may also be used for operative procedures such as tissue repair or the removal of a foreign object (Figure 7.16).
- **Laryngoscopy** (lar-ing-GOS-koh-pee) is the visual examination of the larynx using a **laryngoscope** (**laryng/o** means larynx and **-scopy** means a direct visual examination). This may also be used for operative procedures such as tissue repair or the removal of a foreign object.

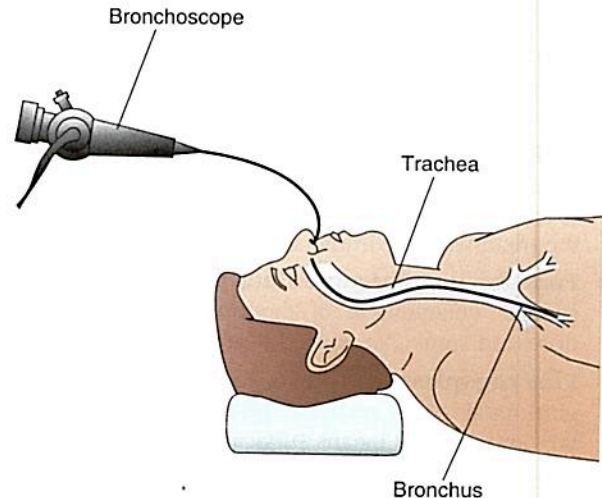


FIGURE 7.16 Bronchoscopy is the visual examination of the bronchi with the use of a bronchoscope.

- **Spirometry** (spy-ROM-eh-tree) is a testing method that uses a spirometer to record the volume of air inhaled or exhaled and the length of time each breath takes (**spir/o** means to breathe and **-metry** means to measure).
- **Tuberculin skin testing (TST)**, which is a screening test to detect tuberculosis, can be performed by the **Mantoux method** or the **PPD** (purified protein derivative). In performing the test, the skin of the arm is injected with a small amount of harmless tuberculin protein. A **negative result** (no response) indicates that TB is not present. A **positive result** (hardness within the testing area within two to three days) indicates the possibility of disease and should be followed by additional testing such as a chest x-ray and sputum testing.
- **Chest imaging**, also known as **chest x-rays**, is a valuable tool to show pneumonia, lung tumors, pneumothorax, pleural effusion, tuberculosis, and emphysema (see Figure 7.10B).

TREATMENT PROCEDURES OF THE RESPIRATORY SYSTEM

MEDICATIONS

- A **bronchoconstrictor** (brong-koh-kon-STRICK-tor) is an agent that narrows the opening of the passages into the lungs.
- A **bronchodilator** (brong-koh-dye-LAY-tor) is an agent that expands the opening of the passages into the lungs. At the first sign of an asthma attack, the patient uses an inhaler to self-administer a bronchodilator.

NOSE AND THROAT

- **Septoplasty** (SEP-toh-plas-tee) is the surgical reconstruction of the nasal septum (**sept/o** means septum and **-plasty** means surgical repair).
- A **sinusotomy** (sigh-nuhs-OT-oh-mee) is a surgical incision into a sinus (**sinus** means sinus and **-otomy** means surgical incision). This procedure is used in the treatment of chronic sinusitis.
- **Functional endoscopic sinus surgery (FSS)** is the surgical enlargement of the opening between the nose and sinus that is used to treat chronic sinusitis.
- **Pharyngoplasty** (fah-RING-goh-plas-tee) is the surgical repair of the pharynx (**pharyng/o** means pharynx and **-plasty** means surgical repair).
- A **pharyngostomy** (far-ing-GOSS-toh-mee) is the surgical creation of an artificial opening into the pharynx (**pharyng** means pharynx and **-ostomy** means surgically creating an opening). The resulting opening is called a **pharyngostoma** (**pharyng/o** means pharynx, and **-stoma** means artificial mouth or opening).
- A **pharyngotomy** (far-ing-GOT-oh-mee) is a surgical incision of the pharynx (**pharyng** means pharynx and **-otomy** means a surgical incision).
- A **laryngectomy** (lar-in-JECK-toh-mee) is the surgical removal of the larynx (**laryng** means larynx and **-ectomy** means surgical removal).
- **Laryngoplasty** (lah-RING-goh-plas-tee) is the surgical repair of the larynx (**laryng/o** means larynx and **-plasty** means surgical repair).
- **Endotracheal intubation** (en-doh-TRAY-kee-al in-too-BAY-shun) is the passage of a tube through the nose or mouth into the trachea to establish an airway. (*Intubation* is the insertion of a tube, usually for the passage of air or fluids.)

TRACHEA AND BRONCHI

- **Tracheoplasty** (TRAY-kee-oh-plas-tee) is the surgical repair of the trachea (**trache/o** means trachea and **-plasty** means surgical repair).
- **Tracheorrhaphy** (tray-kee-OR-ah-fee) means suturing of the trachea (**trache/o** means trachea and **-rrhaphy** means to suture).
- A **tracheotomy** (tray-kee-OT-oh-mee) is usually an emergency procedure in which an incision is made into the trachea to gain access to the airway below a blockage (**trache** means trachea and **-otomy** means surgical incision).
- A **tracheostomy** (tray-kee-OS-toh-mee) is creating an opening into the trachea and inserting a tube to facilitate the passage of air or the removal of secretions (**trache** means trachea and **-ostomy** means surgically creating an opening). Placement of this

tube may be temporary or permanent. The resulting opening is called a stoma.

- A **stoma** (STOH-mah) is an opening on a body surface. A stoma can occur naturally (for example, a pore in the skin) or may be created surgically.

LUNGS, PLEURA, AND THORAX

- A **pneumectomy** (new-moh-NECK-toh-mee) is the surgical removal of all or part of a lung (**pneumon** means lung and **-ectomy** means surgical removal).
- A **lobectomy** (loh-BECK-toh-mee) is the surgical removal of a lobe of the lung. This term also is used to describe the removal of a lobe of the liver, brain, or thyroid gland (**lob** means lobe and **-ectomy** means surgical removal).
- A **pleurectomy** (ploor-ECK-toh-mee) is the surgical removal of part of the pleura (**pleur** means pleura and **-ectomy** means surgical removal).
- **Thoracentesis** (thoh-rah-sen-TEE-sis) is the puncture of the chest wall with a needle to obtain fluid from the pleural cavity for diagnostic purposes, to drain pleural effusions, or to reexpand a collapsed lung (Figure 7.17). (*Notice the spelling of this term. It is not a simple combination of familiar word parts.*)

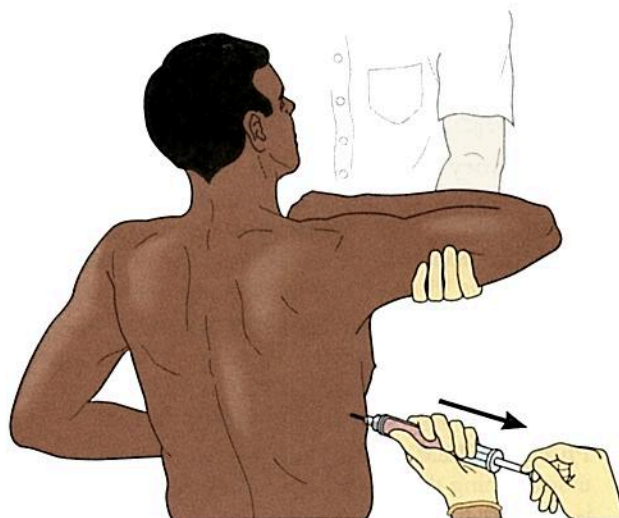


FIGURE 7.17 Fluid being removed from the pleural cavity by means of thoracentesis.

- A **thoracotomy** (thoh-rah-KOT-toh-mee) is a surgical incision into the wall of the chest (**thorac** means thorax or chest and **-otomy** means surgical incision).
- A **thoracostomy** (thoh-rah-KOS-toh-mee) is the surgical creation of an opening into the chest (**thorac** means thorax or chest and **-ostomy** means the surgical creation of an opening).

RESPIRATORY THERAPY

- **Supplemental oxygen** may be administered through a nasal canula or rebreather mask to add more oxygen to the air taken in as the patient breathes.
- **Postural drainage** is a procedure in which the patient is tilted and propped at different angles to drain secretions from the lungs.
- A **ventilator** is a mechanical device for artificial ventilation of the lungs that is used to replace or sup-

plement the patient's natural breathing function. The goal is to wean the patient from the ventilator and to resume breathing on his own.

- A **respirator** is a machine used for prolonged artificial respiration. For example, when a spinal cord injury destroys the natural breathing mechanism, the patient can continue to breathe through the use of a respirator.

Career Opportunities

In addition to the medical specialties already discussed, some of the health occupations involving the treatment of the respiratory system include

- **Respiratory therapist (RT):** treats patients with heart or lung problems by administering oxygen, gases, or aerosol medications under a physician's orders. RTs also use exercises to improve patient breathing, perform diagnostic tests, and connect and monitor ventilators.
- **Respiratory therapy technician (RTT):** works under the supervision of an RT to administer respiratory treatment, perform basic diagnostic tests, clean and maintain equipment, and keep records.

STUDY BREAK

We do it when we're bored. We do it when we're sleepy. We sometimes do it because we see someone else do it. We may try not to, but we can't help ourselves. What is it? A yawn. (The word *yawn* doesn't sound like most other medical terms because it comes from the Anglo-Saxon word *geonian* rather than Latin or Greek.)

A yawn is an involuntary *inhalation* of breath, accompanied by an opened mouth. Why do we yawn? Scientists are not entirely sure, but it seems to be a way for the body to get a sudden surge of oxygen into the lungs and to equalize the pressure in the ear. A spasm in the throat muscles opens the mouth so that we try to take in a deep breath.

We may yawn because

- We are drowsy and not breathing deeply enough.
- The body's vital functions are depressed, for example after a *hemorrhage*.
- The pressure in the ear needs to be equalized, such as during a plane landing.
- We see someone else yawn (try this on a group of friends and see how many can resist!)

Health Occupation Profile: **RESPIRATORY THERAPIST**

Karen Zilles Hickel is a registered respiratory therapist (RT). She specializes in pediatrics, which means she helps children with breathing problems such as asthma and cystic fibrosis. "My job involves giving a variety of treatments including breathing medicines, oxygen, and using small machines to treat diseases of the lung. As a respiratory therapist, I also work in the intensive care unit, where I see children who have had surgery, have been in accidents, or have severe medical problems. When these patients are very sick, they often require a mechanical ventilator or respirator to breathe for them, which is run by an RT. Respiratory therapists are an important part of the hospital's resuscitation team, keeping the patient's airway open and providing oxygen during CPR. I work in a pulmonary clinic, too, where I teach patients and their families how to use devices such as inhalers or nebulizers to treat asthma and encourage them to avoid smoking to keep their lungs healthy. It is very rewarding to help a child breathe more easily!"

Review Time

Write the answers to the following questions on a separate piece of paper or in your notebook. In addition, be prepared to take part in the classroom discussion.

1. **Written assignment:** Identify the four types of **paranasal sinuses** and state the location of each.

Discussion assignment: What is the role of the sinuses and what are the risks of infection in these cavities?

2. **Written assignment:** Use your own words to describe what occurs within the lungs and chest as **emphysema** progresses.

Discussion assignment: How would you explain the progressive nature of emphysema to a patient and her family?

3. **Written assignment:** Using terms a physician would understand, describe the difference between **tuberculosis** and **multidrug-resistant tuberculosis**.

Discussion assignment: Why is tuberculosis a public health threat?

4. **Written assignment:** Using terms the family could understand, describe what happens within the lungs of a child with **cystic fibrosis**.

Discussion assignment: How is cystic fibrosis transmitted, and how it is treated?

5. **Written assignment:** Describe **endotracheal intubation**.

Discussion assignment: State the primary difference between endotracheal intubation and bronchoscopy.

Optional Internet Activity

The goal of this activity is to help you learn more about medical terminology while improving your Internet skills. Select **one** of these two options and follow the instructions.

1. **Internet Search:** Search for information about **SIDS**. Write a brief (one- or two-paragraph) report on something new you learned here and include the address of the web site where you found this information.
2. **Web Site:** To learn more about **asthma**, go to this web address: <http://lungusa.org/>. Under Diseases A to Z, search under A for asthma. Write a brief (one- or two-paragraph) report on something new you learned here.

The Human Touch: Critical Thinking Exercise

The following story and questions are designed to stimulate critical thinking through class discussion or as a brief essay response. There are no right or wrong answers to these questions.

Sylvia Gaylord works as a legal aide on the twelfth floor of an 18-story glass-and-steel monument to modern architectural technology in the center of the city. On clear days, the views are spectacular. From her cubicle, Sylvia's eye catches the edge of a beautiful blue and white skyline as she reaches for her Medibaler. This is the third attack since she returned from lunch four hours ago—her asthma is really bad today. But if she leaves work early again, her boss will write her up. Sylvia concentrates on breathing normally.

Her roommate, Kelly, is a respiratory therapist at the county hospital. Kelly says Sylvia's asthma attacks are probably triggered by the city's high level of air pollution. That can't be true. They both run in the park every morning before work, and Sylvia rarely needs to use her inhaler. The problems start when she gets to work. The wheezing and coughing were so bad today that by the time she got up the elevator and into her cubicle, she could hardly breathe.

Last night, the cable news ran a story on the unhealthy air found in some buildings. They called it "sick building syndrome" and reported that certain employees developed allergic reactions just by breathing the air. "Hmmm," she thought, "it seems like more and more people are getting sick in our office. John has had the flu twice. Sid's bronchitis turned into bronchopneumonia, and Nging complains of sinusitis. Could this building have an air-quality problem?"

Suggested Discussion Topics

1. Discuss which environmental factors might cause an asthma attack.
2. Discuss what Sylvia might do to find out if her building has an air-quality problem.
3. Use proper medical terminology to describe what happens to Sylvia's airways during an asthma attack and how medications affect the symptoms.
4. Asthmatic medications, similar to Sylvia's inhaler, are easily available in drugstores without a prescription. Discuss the pros and cons of this practice.
5. If Sylvia's inhaler does not control her attack and her condition worsens, what steps should be taken promptly? Why?

Student Workbook and Student Activity CD-ROM

1. Go to your **Student Workbook** and complete the Learning Exercises for this chapter.
2. Go to the **Student Activity CD-ROM** and have fun with the exercises and games for this chapter.

The Digestive System

Structures, Word Parts, and Functions of the Digestive System

MAJOR STRUCTURES	RELATED WORD ROOTS	PRIMARY FUNCTIONS
Mouth	or/o	Begins preparation of food for digestion.
Pharynx	pharyng/o	Transports food from the mouth to the esophagus.
Esophagus	esophag/o	Transports food from the pharynx to the stomach.
Stomach	gastr/o	Breaks down food and mixes it with digestive juices.
Small intestines	enter/o	Completes digestion and absorption of most nutrients.
Large intestines	col/o	Absorbs excess water and prepares solid waste for elimination.
Rectum and Anus	an/o, proct/o, rect/o	Controls the excretion of solid waste.
Liver	hepat/o	Secretes bile and enzymes to aid in the digestion of fats.
Gallbladder	cholecyst/o	Stores bile and releases it to the small intestine as needed.
Pancreas	pancreat/o	Secretes digestive juices and enzymes into small intestine as needed.