The respiratory system consists of the lungs and the air passageways that connect the lungs to the outside of the body.

Dive In!

- On April 30, 2003, David Blaine set the world record by holding his breath (after breathing pure oxygen) for 17 minutes, 4.4 seconds.
- The average person takes about 300 million breaths in a lifetime.
- In the uterus, a fetus does not breathe. It takes its first breath at birth.
- In this chapter you'll explore the respiratory system. You'll breathe a sigh of relief after you master the medical language of pulmonology!

Soap bubbles and balloons look like alveoli, the tiny clusters of air sacs inside the lungs.

1816

The first stethoscope is invented by Dr. Rene Laennec of France

1818

The first blood transfusion is performed by Dr. James Blundell, a British obstetrician. A husband gives blood to his wife when she hemorrhages after giving birth.
Pulmonology (pul-moh-NAWL-oh-jee) is the medical specialty that studies the anatomy and physiology of the respiratory system and uses diagnostic tests, medical and surgical procedures, and drugs to treat respiratory diseases.

Blowing up a balloon may look simple, but there's a lot happening in those little lungs.
Measure Your Progress: Learning Objectives

After you study this chapter, you should be able to

1. Identify the structures of the respiratory system.
2. Describe the process of respiration.
3. Describe common respiratory diseases and conditions, laboratory and diagnostic procedures, medical and surgical procedures, and drug categories.
4. Give the medical meaning of word parts related to the respiratory system.
5. Build respiratory words from word parts and divide and define respiratory words.
6. Spell and pronounce respiratory words.
7. Analyze the medical content and meaning of a pulmonology report.
8. Dive deeper into pulmonology by reviewing the activities at the end of this chapter and online at Medical Terminology Interactive.

Medical Language Key

To unlock the definition of a medical word, break it into word parts. Define each word part. Put the word part meanings in order, beginning with the suffix, then the prefix (if present), then the combining form(s).

<table>
<thead>
<tr>
<th>Word Part</th>
<th>Word Part Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>-logy</td>
<td>the study of</td>
</tr>
<tr>
<td>pulmon/o-</td>
<td>means lung</td>
</tr>
</tbody>
</table>

Pulmonology: The study of the lungs (and related structures).

Figure 4-1  ▶ Respiratory system.
The respiratory system consists of two main organs—the lungs—and other structures connected to the lungs. These form a pathway through which air flows into and out of the body.
Anatomy and Physiology

The **respiratory system** consists of the right and left lungs and the air pas sageways that connect the lungs to the outside of the body (see Figure 4-1 ■). The upper respiratory system in the head and neck includes the nose, nasal cavity, and pharynx (throat). The upper respiratory system shares these structures with the ears, nose, and throat system (discussed in “Otolaryngology,” Chapter 16). The lower respiratory system includes the larynx (voice box) and trachea (windpipe) in the neck and the bronchi, bronchioles, and alveoli in the lungs. The lungs fill much of the thoracic cavity. The purpose of the respiratory system is to bring oxygen into the body and expel the waste product carbon dioxide.

**Word Alert**

The respiratory system is also known as the **respiratory tract**. A tract is a pathway. The adjective **cardiopulmonary** reflects the connection between the heart and the respiratory system. Without the heart, oxygen brought into the lungs would never reach the rest of the body, and carbon dioxide produced by the cells in the body would never reach the lungs to be exhaled.

### Anatomy of the Respiratory System

#### Nose and Nasal Cavity

The nose contains the **nasal cavity**, which is divided in the center by the nasal septum. On each side of the cavity are three long, bony projections: the superior, middle, and inferior **turbinates** or **nasal conchae** (see Figure 4-2 ■). These jut into the nasal cavity and slow down inhaled air so that it can be warmed and moistened. The nasal cavity is lined with **mucosa**, a **mucous membrane** that humidifies the air and produces **mucus**. Mucus and hairs in the nose trap inhaled particles of dust, pollen, smoke, and bacteria and keep them from entering the lungs. The sinuses in the bones help the body maintain its core temperature and keeps the tissues of the lungs from becoming dehydrated.

**Figure 4-2 ■ Nasal cavity.**

Air entering the nasal cavity swirls around the turbinates, allowing the mucosa to warm and moisten it before it goes to the lungs. This helps the body maintain its core temperature and keeps the tissues of the lungs from becoming dehydrated. The mucosa also produces mucus to trap inhaled particles and bacteria before they enter the lungs.
around the nose and elsewhere in the skull are discussed in “Otolaryngology,” Chapter 16.

Pharynx

Posteriorly, the nasal cavity merges with the throat or pharynx. The nasopharynx is the area of the throat that is posterior to the nasal cavity, the oropharynx is the area of the throat that is posterior to the oral cavity, and the laryngopharynx is posterior to the larynx. The mucous membranes of the pharynx also warm and moisten inhaled air and trap particles. The pharynx is a common passageway for both air and food.

Larynx

At its inferior end, the pharynx divides into two parts: the larynx that leads to the trachea and the esophagus that leads to the stomach (see Figure 4-3 ■). The larynx or voice box remains open during respiration and speech, allowing air to pass in and out through the vocal cords. During swallowing, muscles in the neck pull the larynx up to meet the epiglottis, a lidlike structure. It seals off the entrance to the larynx so that swallowed food moves across the epiglottis and into the esophagus, not into the trachea.
**Trachea**

Below the vocal cords, the larynx merges into the trachea. The **trachea** or windpipe is about 1 inch in diameter and 4 inches in length. It is a passageway for inhaled and exhaled air (see Figure 4-4 ■). A column of C-shaped rings of cartilage provide support to the trachea. On the posterior surface where there is no cartilage, the trachea is flexible and can flatten to make room when a large amount of swallowed food passes through the esophagus.

**Bronchi**

The inferior end of the trachea splits to become the right and left primary **bronchi** (see Figure 4-4). The primary bronchi contain cartilage rings for support. Each primary bronchus enters a lung and branches into smaller **bronchioles**. The smallest bronchioles (with a diameter of 1 mm or less) have smooth muscle around them, but no cartilage. The **lumen** is the central opening in the bronchi and bronchioles through which air passes. **Bronchopulmonary** refers to the bronchi and the lungs.

The trachea, bronchi, and bronchioles look like the trunk and branches of an upside-down tree and are called the **bronchial tree**. The bronchial tree is lined with **cilia**, small hairs that flow in coordinated waves to move mucus and trapped particles toward the throat where they are expelled by coughing or are swallowed.

**Did You Know?**

Smoking immobilizes and eventually destroys the cilia. Without cilia, smoke particles easily enter the lung and are deposited there permanently. The normally pink lung tissue becomes gray in color with speckles of black.
Lungs

The lungs are spongy, air-filled structures. Each lung contains lobes, large divisions whose dividing lines are visible on the outer surface of the lung (see Figure 4-4). The right lung, which is larger, has three lobes: the right upper lobe (RUL), the right middle lobe (RML), and the right lower lobe (RLL). The left lung has two lobes: the left upper lobe (LUL) and the left lower lobe (LLL). The rounded top of each lung is the apex. The base of each lung lies along the diaphragm (see Figure 4-4). A bronchus enters the lung at the hilum (an indentation on the medial surface of the lung). The pulmonary arteries and pulmonary veins for each of the lobes also enter and exit there.

Inside the lung, the bronchus branches into bronchioles, which branch into alveoli. An alveolus is a hollow sphere of cells that expands and contracts with each breath (see Figure 4-4). Oxygen and carbon dioxide are exchanged between the alveolus and a nearby small blood vessel (capillary). The alveolus secretes surfactant, a protein-fat compound that reduces surface tension and keeps the walls of the alveolus from collapsing with each exhalation. Collectively, the alveoli are the pulmonary parenchyma, the functional part of the lung, as opposed to the connective tissue framework around them.

Thoracic Cavity

The thorax is a bony cage that consists of the sternum (breast bone) anteriorly, the ribs laterally, and the spinal column posteriorly. The thorax surrounds and protects the thoracic cavity. The lungs take up most of the space on either side of the thoracic cavity. Between the lungs lies the mediastinum, an irregularly shaped area that contains the trachea (and the heart and esophagus). The diaphragm, a sheet of skeletal muscle, lies along the inferior border of the thoracic cavity (see Figure 4-5). The diaphragm is active during breathing.

Figure 4-5 ■ Diaphragm and pleura.

The diaphragm is the inferior border of the thoracic cavity. The pleura folds back on itself to make two layers. The visceral pleura covers the surface of the lungs. The parietal pleura lines the thoracic cavity. The pleural space between the two layers is filled with pleural fluid.
Each lung is located within a pleural cavity that is surrounded by pleura, a double-layered serous membrane (see Figure 4-5). The visceral pleura is the layer next to the lung surface, while the parietal pleura is the layer next to the wall of the thorax. The pleura secretes pleural fluid into the pleural space, the narrow space between its two layers. Pleural fluid is a slippery, watery fluid that allows the two layers to slide smoothly past each other as the lungs expand and contract during respiration.

**Physiology of Respiration**

Respiration consists of breathing in and breathing out. Breathing in is inhalation or inspiration. Breathing out is exhalation or expiration. Breathing is normally an involuntary process that occurs without any conscious effort. Respiratory control centers in the brain regulate the depth and rate of respiration. Receptors in large arteries in the chest and neck send these centers information about the blood level of oxygen, and receptors in the brain send information about the blood level of carbon dioxide. Based on this information, the respiratory control centers control the rate of respiration by sending nerve impulses to the phrenic nerve, causing the diaphragm to contract. You can voluntarily control your respirations (when you hold your breath), but eventually involuntary control takes over, forcing you to breathe.

During inhalation, the diaphragm contracts and moves downward as the intercostal muscles between the ribs pull the ribs up and out. This enlarges the thoracic cavity and creates negative internal pressure that causes air to flow into the lungs. During exhalation, the diaphragm and intercostal muscles relax, the thoracic cavity returns to its previous size, and air flows slowly out of the nose. A different set of intercostal muscles contracts to pull the ribs down and in to expel air during forceful exhalation (see Figure 4-6 ■). Having a normal depth and rate of respiration is known as eupnea.

**Figure 4-6 ■ Exhalation.**

When you want to forcefully exhale air, your brain tells one set of the intercostal muscles between the ribs as well as the abdominal muscles to contract. This quickly decreases the size of the thoracic cavity and expels a large volume of air in just a few seconds—perfect for blowing bubbles, blowing up a balloon, or whistling.
Respiration involves five separate processes.

1. **Ventilation.** Movement of air in and out of the lungs.
2. **External respiration.** Movement of oxygen from the alveoli into the blood and the movement of carbon dioxide from the blood into the alveoli (see Figure 4-7 ■).
3. **Gas transport.** Transport of oxygen and carbon dioxide in the blood. Oxygen molecules in the blood bind with the hemoglobin in red blood cells to form oxyhemoglobin. Oxygenated blood travels from the lungs to the heart, where it is pumped throughout the body to reach every cell. Carbon dioxide also binds with hemoglobin in the red blood cells.
4. **Internal respiration.** Movement of oxygen from the blood into the cells and movement of carbon dioxide from the cells into the blood. Internal respiration is the exchange of these gases at the cellular level.
5. **Cellular respiration.** Oxygen is used by the cell to produce energy in the process of metabolism. Carbon dioxide is a gaseous waste product of metabolism.

The respiratory system is solely responsible for the first process. The respiratory system and cardiovascular system share responsibility for the second process. The rest of the processes are done by the cardiovascular system and/or the individual cell.

---

**WORD BUILDING**

- **ventilation** (ven-tih-lay-shun)
  - venti/o- movement of air
  - -ation a process; being or having

- **oxygen** (AWK-seh-jen)
  - The combining forms ox/i-, ox/o-, and ox/y- mean oxygen.

- **carbon dioxide** (KAR-bun dy-AWK-side)
  - The combining form capn/o- means carbon dioxide.

- **oxyhemoglobin** (AWK-see-HEE-moh-GLOH-bin)
  - ox/y- oxygen; quick
  - hem/o- blood
  - glob/o- shaped like a globe; comprehensive
  - -in a substance

- **oxygenated** (AWK-see-jen-AA-ted)
  - ox/y- oxygen; quick
  - gen/o- arising from; produced by
  - -ated pertaining to a condition; composed of

- **cellular** (SEL-yoo-lar)
  - cellul/o- cell
  - -ar pertaining to

- **metabolism** (meh-TAB-oh-lizm)
  - metabol/o- change; transformation
  - -ism process; disease from a specific cause

---

**Figure 4-7 ■ Gas exchange.**

Oxygen moves from the alveoli into the blood, binds to hemoglobin in a red blood cell, and is carried to the cells of the body. Carbon dioxide comes from each cell as a waste product of metabolism. It dissolves in the blood or binds to hemoglobin and is carried to the lungs where it is exhaled by the lung.
### Word Alert

**SOUND-ALIKE WORDS**

<table>
<thead>
<tr>
<th>Word</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>breath</strong> (noun)</td>
<td>the air that flows in and out of the lungs</td>
<td>The breath of a diabetic patient can have a fruity odor to it.</td>
</tr>
<tr>
<td><strong>breathe</strong> (verb)</td>
<td>the action of inhaling and exhaling</td>
<td>If you ask an asthmatic patient to breathe deeply, you might hear a wheezing sound.</td>
</tr>
<tr>
<td><strong>mucosa</strong> (noun)</td>
<td>a Latin word that means mucous membrane</td>
<td>If a patient needs more oxygen, the oral mucosa might have a bluish color to it.</td>
</tr>
<tr>
<td><strong>mucous</strong> (adjective)</td>
<td>pertaining to a membrane (the mucosa) that secretes mucus</td>
<td>Allergies make the mucous membranes of the nose swollen and inflamed.</td>
</tr>
<tr>
<td><strong>mucus</strong> (noun)</td>
<td>a secretion from a mucous membrane</td>
<td>A chronic smoker coughs often and produces a significant amount of mucus.</td>
</tr>
</tbody>
</table>

### Across the Life Span

**Pediatrics.** In the uterus, the fetus does not breathe, and its lungs are collapsed. Instead, it receives oxygen from the mother’s lungs via the placenta and umbilical cord. The lungs of the fetus do not function until the very first breath after birth. At that time, they must expand fully and stay expanded (which is helped by the presence of surfactant).

The normal respiratory rate for a newborn infant is 30–60 breaths per minute. The normal respiratory rate for an adult is 12–20 breaths per minute. One inhalation and one exhalation are counted as one respiration.

**Geriatrics.** As a person ages, some alveoli deteriorate. Because the body does not repair or replace alveoli, the total number of alveoli in the lungs continues to decline with age, and the remaining alveoli are less elastic. The thorax becomes stiff and less able to expand on inhalation. In addition, a lifetime of exposure to air pollution, chemical fumes, and smoke causes damage to the lungs. All of these changes decrease the pulmonary function in older adults.
## Vocabulary Review

### Anatomy and Physiology

<table>
<thead>
<tr>
<th>Word or Phrase</th>
<th>Description</th>
<th>Combining Forms</th>
</tr>
</thead>
<tbody>
<tr>
<td>cardiopulmonary</td>
<td>Pertaining to the heart and lungs</td>
<td>cardi/o- heart</td>
</tr>
<tr>
<td>respiratory system</td>
<td>Body system that brings oxygen into the body and expels carbon dioxide. The upper respiratory system includes the nose, nasal cavity, and pharynx (throat). The lower respiratory system includes the larynx (voice box), trachea (windpipe) in the neck and the bronchi, bronchioles, and alveoli (in the lungs). It is also known as the respiratory tract.</td>
<td>pulmon/o- lung</td>
</tr>
<tr>
<td>mucosa</td>
<td><strong>Mucous membrane</strong> that lines the entire respiratory system. It warms and humidifies incoming air. It produces mucus to trap foreign particles.</td>
<td>muscos/o- mucus membrane</td>
</tr>
<tr>
<td>nasal cavity</td>
<td>Hollow area inside the nose</td>
<td>nas/o- nose</td>
</tr>
<tr>
<td>pharynx</td>
<td>The throat. A shared passageway for both air and food. The nasopharynx is posterior to the nasal cavity, the oropharynx is posterior to the oral cavity, and the laryngopharynx is posterior to the larynx.</td>
<td>pharyng/o- pharynx (throat)</td>
</tr>
<tr>
<td>septum</td>
<td>Wall of cartilage and bone that divides the nasal cavity into right and left sides</td>
<td>sept/o- septum (dividing wall)</td>
</tr>
<tr>
<td>turbinates</td>
<td>Three long, bony projections (superior, middle, and inferior) on either side of the nasal cavity. They break up and slow down inhaled air. They are also known as the nasal conchae.</td>
<td>turbin/o- scroll-like structure; turbinate</td>
</tr>
</tbody>
</table>

### Upper Respiratory System

#### Mucosa
- Mucous membrane
  - **Description**: Mucous membrane that lines the entire respiratory system. It warms and humidifies incoming air. It produces mucus to trap foreign particles.
  - **Combining Forms**: muscos/o- mucous membrane, muc/o- mucus

#### Nasal Cavity
- **Description**: Hollow area inside the nose
- **Combining Forms**: nas/o- nose

#### Pharynx
- **Description**: The throat. A shared passageway for both air and food. The nasopharynx is posterior to the nasal cavity, the oropharynx is posterior to the oral cavity, and the laryngopharynx is posterior to the larynx.
  - **Combining Forms**: pharyng/o- pharynx (throat), nas/o- nose, or/o- mouth, laryng/o- larynx (voice box)

#### Septum
- **Description**: Wall of cartilage and bone that divides the nasal cavity into right and left sides
- **Combining Forms**: sept/o- septum (dividing wall)

#### Turbinates
- **Description**: Three long, bony projections (superior, middle, and inferior) on either side of the nasal cavity. They break up and slow down inhaled air. They are also known as the nasal conchae.
- **Combining Forms**: turbin/o- scroll-like structure; turbinate

### Lower Respiratory System

#### Alveolus
- **Description**: Hollow sphere of cells in the lungs where oxygen and carbon dioxide are exchanged
- **Combining Forms**: alveol/o- alveolus (air sac)

#### Apex
- **Description**: Rounded top of each lung

#### Bronchiole
- **Description**: Small tubular air passageway that branches off from a bronchus and then branches into several alveoli. Its wall contains smooth muscle.
- **Combining Forms**: bronchiol/o- bronchiole

#### Bronchus
- **Description**: Tubular air passageway that forms an inverted Y below the trachea. Each primary bronchus enters a lung and branches into bronchioles. The bronchial tree includes the trachea, bronchi, and bronchioles. Bronchopulmonary refers to the bronchi and the lungs.
  - **Combining Forms**: bronchi/o- bronchus, bronch/o- bronchus, pulmon/o- lung

#### Cilia
- **Description**: Small hairs that flow in waves to move foreign particles away from the lungs and toward the nose and the throat where they can be expelled

#### Epiglottis
- **Description**: Lidlike structure that seals off the larynx, so that swallowed food goes into the esophagus, not into the trachea
- **Combining Forms**: glott/o- glottis (of the larynx)
<table>
<thead>
<tr>
<th>Word or Phrase</th>
<th>Description</th>
<th>Combining Forms</th>
</tr>
</thead>
<tbody>
<tr>
<td>hilum</td>
<td>Indentation on the medial side of a lung where the bronchus, pulmonary arteries, and nerves enter the lung and the pulmonary veins exit</td>
<td>hil/o- hilum (indentation in an organ)</td>
</tr>
<tr>
<td>larynx</td>
<td>Structure that contains the vocal cords and is a passageway for inhaled and exhaled air. It is also known as the voice box.</td>
<td>laryng/o- larynx (voice box)</td>
</tr>
<tr>
<td>lobe</td>
<td>Large division of a lung, visible on the outer surface</td>
<td>lob/o- lobe of an organ</td>
</tr>
<tr>
<td>lumen</td>
<td>Central opening through which air flows inside the trachea, a bronchus, or a bronchiole</td>
<td></td>
</tr>
<tr>
<td>lung</td>
<td>Organ of respiration that contains alveoli</td>
<td>pneum/o- lung; air pneumon/o- lung; air pulmon/o- lung</td>
</tr>
<tr>
<td>parenchyma</td>
<td>Functional part of the lung (i.e., the alveoli) as opposed to the connective tissue framework</td>
<td></td>
</tr>
<tr>
<td>surfactant</td>
<td>Protein–fat compound that reduces surface tension and keeps the walls of the alveolus from collapsing with each exhalation</td>
<td></td>
</tr>
<tr>
<td>trachea</td>
<td>Vertical tube with C-shaped rings of cartilage in it. It is an air passageway between the larynx and the bronchi.</td>
<td>trache/o- trachea (windpipe)</td>
</tr>
</tbody>
</table>

**Thoracic Cavity**

<table>
<thead>
<tr>
<th>Word or Phrase</th>
<th>Description</th>
<th>Combining Forms</th>
</tr>
</thead>
<tbody>
<tr>
<td>diaphragm</td>
<td>Muscular sheet that divides the thoracic cavity from the abdominal cavity</td>
<td>diaphragmat/o- diaphragm</td>
</tr>
<tr>
<td>intercostal muscles</td>
<td>Two sets of muscles between the ribs that contract to pull the ribs up and out during inhalation or down and in during forceful exhalation</td>
<td>cost/o- rib</td>
</tr>
<tr>
<td>mediastinum</td>
<td>Smaller cavity within the thoracic cavity. It contains the trachea (and other structures such as the heart).</td>
<td></td>
</tr>
<tr>
<td>phrenic nerve</td>
<td>Nerve that, when stimulated, causes the diaphragm to contract and move inferiorly to expand the thoracic cavity during inspiration</td>
<td>phren/o- diaphragm; mind</td>
</tr>
<tr>
<td>pleura</td>
<td>Double-layered serous membrane. The visceral pleura is next to the lung surface. The parietal pleura is next to the wall of the thorax. The pleura secretes pleural fluid into the pleural space (the space between the two layers of pleura).</td>
<td>pleur/o- pleura (lung membrane) viscer/o- large internal organs pariet/o- wall of a cavity</td>
</tr>
<tr>
<td>pleural cavity</td>
<td>Hollow space that contains each lung</td>
<td>pleur/o- pleura (lung membrane)</td>
</tr>
<tr>
<td>thoracic cavity</td>
<td>Hollow space that is filled with the lungs and structures in the mediastinum</td>
<td>thorac/o- thorax (chest)</td>
</tr>
<tr>
<td>thorax</td>
<td>Bony cage of the sternum and ribs and the spinal column posteriorly that surrounds and protects the lungs and other organs in the thoracic cavity</td>
<td>thorac/o- thorax (chest) pector/o- chest steth/o- chest</td>
</tr>
</tbody>
</table>
## Respiration

<table>
<thead>
<tr>
<th>Word or Phrase</th>
<th>Description</th>
<th>Combining Forms</th>
</tr>
</thead>
<tbody>
<tr>
<td>carbon dioxide</td>
<td>Exhaled gas that is a waste product of cellular metabolism. It is carried in the blood and by the hemoglobin in red blood cells.</td>
<td>capn/o- carbon dioxide</td>
</tr>
<tr>
<td>eupnea</td>
<td>Normal rate and rhythm of breathing</td>
<td>pne/o- breathing</td>
</tr>
<tr>
<td>exhalation</td>
<td>Breathing out. It is also known as expiration.</td>
<td>hal/o- breathe; spir/o- breathe; a coil</td>
</tr>
<tr>
<td>inhalation</td>
<td>Breathing in. It is also known as inspiration.</td>
<td>hal/o- breathe; spir/o- breathe; a coil</td>
</tr>
<tr>
<td>metabolism</td>
<td>Process of using oxygen to produce energy for cells. Metabolism produces carbon dioxide and other waste products.</td>
<td>metabol/o- change; transformation</td>
</tr>
<tr>
<td>oxygen</td>
<td>Inhaled gas that is used by each cell to produce energy in the process of metabolism. Oxygen is carried in the blood and by the hemoglobin in red blood cells. Blood that contains a high level of oxygen is oxygenated.</td>
<td>ox/y- oxygen; quick ox/i- oxygen ox/o- oxygen gen/o- arising from; produced by</td>
</tr>
<tr>
<td>oxyhemoglobin</td>
<td>Compound formed when oxygen combines with the hemoglobin in red blood cells</td>
<td>ox/y- oxygen; quick hem/o- blood glob/o- shaped like a globe; comprehensive</td>
</tr>
<tr>
<td>respiration</td>
<td>Consists of five processes: ventilation (movement of air in and out of the lungs), external respiration (exchange of oxygen and carbon dioxide between the alveoli and the blood), gas transport through the blood, internal respiration (exchange of oxygen and carbon dioxide between the blood and the cells), and cellular respiration (use of oxygen to produce energy in the cell and the production of carbon dioxide as a waste product of metabolism).</td>
<td>spir/o- breathe; a coil ventil/o- movement of air cellul/o- cell</td>
</tr>
<tr>
<td>respiratory control centers</td>
<td>Centers in the brain that regulate the depth and rate of respiration</td>
<td>spir/o- breathe; a coil</td>
</tr>
</tbody>
</table>
Match each anatomy word or phrase to its structure and write it in the numbered box for each figure. Be sure to check your spelling. Use the Answer Key at the end of the book to check your answers.

<table>
<thead>
<tr>
<th>apex of lung</th>
<th>cluster of alveoli</th>
<th>lower lobe of lung</th>
<th>rib</th>
</tr>
</thead>
<tbody>
<tr>
<td>bronchioles</td>
<td>bronchus</td>
<td>nasal cavity</td>
<td>sternum</td>
</tr>
<tr>
<td>bronchiole</td>
<td></td>
<td>pharynx</td>
<td>trachea</td>
</tr>
</tbody>
</table>

1. 
2. 
3. 
4. 
5. 
6. 
7. 
8. 
9. 
10. 
11. 
12. 

<table>
<thead>
<tr>
<th>bronchiole</th>
<th>capillary wall</th>
<th>carbon dioxide</th>
<th>cluster of alveoli</th>
<th>oxygen</th>
<th>red blood cell</th>
</tr>
</thead>
</table>

1. 
2. 
3. 
4. 
5. 
6.
# Building Medical Words

*Use the Answer Key at the end of the book to check your answers.*

## Combining Forms Exercise

Before you build respiratory words, review these combining forms. Next to each combining form, write its medical meaning. The first one has been done for you.

<table>
<thead>
<tr>
<th>Combining Form</th>
<th>Medical Meaning</th>
<th>Combining Form</th>
<th>Medical Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>alveol/o-</strong></td>
<td>alveolus (air sac)</td>
<td><strong>22. or/o-</strong></td>
<td></td>
</tr>
<tr>
<td><strong>bronchi/o-</strong></td>
<td></td>
<td><strong>23. ox/i-</strong></td>
<td></td>
</tr>
<tr>
<td><strong>bronchiol/o-</strong></td>
<td></td>
<td><strong>24. ox/o-</strong></td>
<td></td>
</tr>
<tr>
<td><strong>bronch/o-</strong></td>
<td></td>
<td><strong>25. ox/y-</strong></td>
<td></td>
</tr>
<tr>
<td><strong>capn/o-</strong></td>
<td></td>
<td><strong>26. pariet/o-</strong></td>
<td></td>
</tr>
<tr>
<td><strong>cardi/o-</strong></td>
<td></td>
<td><strong>27. pector/o-</strong></td>
<td></td>
</tr>
<tr>
<td><strong>cellul/o-</strong></td>
<td></td>
<td><strong>28. pharyng/o-</strong></td>
<td></td>
</tr>
<tr>
<td><strong>cost/o-</strong></td>
<td></td>
<td><strong>29. phren/o-</strong></td>
<td></td>
</tr>
<tr>
<td><strong>diaphragmat/o-</strong></td>
<td></td>
<td><strong>30. pleur/o-</strong></td>
<td></td>
</tr>
<tr>
<td><strong>gen/o-</strong></td>
<td></td>
<td><strong>31. pne/o-</strong></td>
<td></td>
</tr>
<tr>
<td><strong>glob/o-</strong></td>
<td></td>
<td><strong>32. pneum/o-</strong></td>
<td></td>
</tr>
<tr>
<td><strong>glott/o-</strong></td>
<td></td>
<td><strong>33. pneumon/o-</strong></td>
<td></td>
</tr>
<tr>
<td><strong>hal/o-</strong></td>
<td></td>
<td><strong>34. pulmon/o-</strong></td>
<td></td>
</tr>
<tr>
<td><strong>hem/o-</strong></td>
<td></td>
<td><strong>35. sept/o-</strong></td>
<td></td>
</tr>
<tr>
<td><strong>hil/o-</strong></td>
<td></td>
<td><strong>36. spir/o-</strong></td>
<td></td>
</tr>
<tr>
<td><strong>laryng/o-</strong></td>
<td></td>
<td><strong>37. steth/o-</strong></td>
<td></td>
</tr>
<tr>
<td><strong>lob/o-</strong></td>
<td></td>
<td><strong>38. thorac/o-</strong></td>
<td></td>
</tr>
<tr>
<td><strong>metabol/o-</strong></td>
<td></td>
<td><strong>39. trache/o-</strong></td>
<td></td>
</tr>
<tr>
<td><strong>muc/o-</strong></td>
<td></td>
<td><strong>40. turbin/o-</strong></td>
<td></td>
</tr>
<tr>
<td><strong>mucos/o-</strong></td>
<td></td>
<td><strong>41. ventil/o-</strong></td>
<td></td>
</tr>
<tr>
<td><strong>nas/o-</strong></td>
<td></td>
<td><strong>42. viscer/o-</strong></td>
<td></td>
</tr>
</tbody>
</table>
Combining Form and Suffix Exercise

Read the definition of the medical word. Look at the combining form that is given. Select the correct suffix from the Suffix List and write it on the blank line. Then build the medical word and write it on the line. (Remember: You may need to remove the combining vowel. Always remove the hyphens and slash.) Be sure to check your spelling. The first one has been done for you.

<table>
<thead>
<tr>
<th>Definition of the Medical Word</th>
<th>Combining Form</th>
<th>Suffix</th>
<th>Build the Medical Word</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pertaining to the alveolus</td>
<td>alveol/o-</td>
<td>-ar</td>
<td>alveolar</td>
</tr>
<tr>
<td>(You think pertaining to (-ar) + the alveolus (alveol/o-). You change the order of the word parts to put the suffix last. You write alveolar.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Pertaining to the nose</td>
<td>nas/o-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Pertaining to the trachea</td>
<td>trache/o-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Pertaining to the lungs</td>
<td>pulmon/o-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Pertaining to (the nerve for) the diaphragm</td>
<td>phren/o-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Small thing (that comes from a) bronchus</td>
<td>bronchi/o-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Pertaining to the chest</td>
<td>thorac/o-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Pertaining to a lobe of the lung</td>
<td>lob/o-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. The study of the lung (and related structures)</td>
<td>pulmon/o-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. A process of movement of air</td>
<td>ventil/o-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Process of change or transformation (that happens within a cell)</td>
<td>metabol/o-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Pertaining to the bronchus</td>
<td>bronchi/o-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Pertaining to the bronchiole</td>
<td>bronchiol/o-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Pertaining to the larynx</td>
<td>laryng/o-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Pertaining to the mucosa</td>
<td>mucos/o-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Pertaining to the diaphragm</td>
<td>diaphragmat/o-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Pertaining to the pharynx</td>
<td>pharyng/o-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Prefix Exercise

Read the definition of the medical word. Look at the medical word or partial word that is given (it already contains a combining form and suffix). Select the correct prefix from the Prefix List and write it on the blank line. Then build the medical word and write it on the line. Be sure to check your spelling. The first one has been done for you.

<table>
<thead>
<tr>
<th>Definition of the Medical Word</th>
<th>Prefix</th>
<th>Word or Partial Word</th>
<th>Build the Medical Word</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Process of (taking) in a breath</td>
<td>in-</td>
<td>spiration</td>
<td>inspiration</td>
</tr>
<tr>
<td>2. Pertaining to between the ribs</td>
<td></td>
<td>costal</td>
<td></td>
</tr>
<tr>
<td>3. Process of again and again breathing</td>
<td></td>
<td>spiration</td>
<td></td>
</tr>
<tr>
<td>4. Pertaining to above the glottis</td>
<td></td>
<td>glottic</td>
<td></td>
</tr>
<tr>
<td>5. Process of (letting) out a breath</td>
<td></td>
<td>halation</td>
<td></td>
</tr>
<tr>
<td>6. Pertaining to again and again breathing</td>
<td></td>
<td>spiratory</td>
<td></td>
</tr>
</tbody>
</table>

Multiple Combining Forms and Suffix Exercise

Read the definition of the medical word. Select the correct suffix and combining forms. Then build the medical word and write it on the line. Be sure to check your spelling. The first one has been done for you.

<table>
<thead>
<tr>
<th>Definition of the Medical Word</th>
<th>Combining Form</th>
<th>Combining Form</th>
<th>Suffix</th>
<th>Build the Medical Word</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pertaining to the heart and lungs</td>
<td>cardi/o-</td>
<td>pulmon/o-</td>
<td>-ary</td>
<td>cardiopulmonary</td>
</tr>
<tr>
<td>(You think pertaining to (-ary) + heart (cardi/o-)) + lungs (pulmon/o-) You change the order of the word parts to put the suffix last. You write cardiopulmonary.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Pertaining to a condition (in which there is) oxygen arising from (the blood)</td>
<td>bronch/o-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Pertaining to the bronchi and lungs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. A substance (that carries) oxygen (in the) blood (and is) shaped like a globe</td>
<td>gen/o-</td>
<td>glob/o-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Diseases and Conditions

Note: Diseases and conditions of the nose and pharynx are discussed in “Otolaryngology,” Chapter 16.

Nose and Pharynx

<table>
<thead>
<tr>
<th>Word or Phrase</th>
<th>Description</th>
<th>Word Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>upper respiratory infection (URI)</td>
<td>Bacterial or viral infection of the nose and/or throat. It is also known as the common cold or a head cold (see Figure 4-8). Treatment: Antibiotic drugs for bacterial infections.</td>
<td>infection (in-FEK-shun) infect/o- disease within -ion action; condition</td>
</tr>
</tbody>
</table>

Figure 4-8 Upper respiratory infection.
The common cold is an upper respiratory infection caused by a bacterium or virus. It spreads easily to others on unwashed hands or by droplets of mucus and saliva that are expelled into the air during sneezing and coughing.

Trachea, Bronchi, and Bronchioles

asthma
Hyperreactivity of the bronchi and bronchioles with bronchospasm (contraction of the smooth muscle). Inflammation and swelling severely narrow the lumens. Attacks are triggered by exposure to allergens, dust, mold, smoke, inhaled chemicals, exercise, cold air, or emotional stress. It is also known as reactive airway disease. There is severe shortness of breath, mucus production, coughing, audible wheezing, and difficulty exhaling. Patients with asthma are said to be asthmatic. Status asthmaticus is a prolonged, extremely severe, life-threatening asthma attack. Treatment: Avoid things that trigger asthma attacks. Corticosteroid drugs, bronchodilator drugs, and leukotriene receptor blocker drugs to prevent attacks. Inhaled bronchodilator drugs during attacks. Oxygen and epinephrine (Adrenalin) for severe attacks.

asthma (AZ-mah)
bronchospasm (BRONG-koh-spazm)
bronch/o- bronchus -spasm sudden, involuntary muscle contraction
asthmatic (az-MAT-ik)
asthm/o- asthma -atic pertaining to
status asthmaticus (STAT-us az-MAT-ih-kus)

Clinical Connections

Public Health. Asthma is prevalent in poor inner-city children. Researchers found that exposure to cockroaches appears to be a strong asthma trigger. Extermination of live cockroaches does not eliminate the problem because cockroach droppings and carcasses remain behind the walls of apartment buildings.

Bronchitis

Acute or chronic inflammation or infection of the bronchi. Inflammation is due to pollution or smoking, and this causes a constant cough, mucus production, and wheezing. Chronic bronchitis is part of chronic obstructive pulmonary disease (COPD). Bronchitis with infection is due to bacteria or viruses. There is coughing, mucus production, wheezing, and a fever. Treatment: Bronchodilator drugs and corticosteroid drugs for inflammation. Antibiotic drugs for a bacterial infection.

**Did You Know?**

Pack-years are a standardized way to express as a single number the amount and duration of cigarette smoking. Pack-years equal the number of packs smoked per day multiplied by the number of years of smoking.

**Bronchiectasis**

Chronic, permanent enlargement and loss of elasticity of the bronchioles. Chronic inflammation destroys the smooth muscle, and the bronchioles become overdilated. There is a large amount of mucus with coughing. It is often seen in patients with cystic fibrosis. Treatment: Bronchodilator drugs. Oxygen therapy.

**Lungs**

Abnormal Inspiration Sounds

Normal inspiration sounds like a soft wind rushing through a tunnel. Abnormal breath sounds include a pleural friction rub, rales, rhonchi, stridor, or wheezes.

**A Closer Look**

**Pleural friction rub:** Creaking, grating, or rubbing sound when the two layers of inflamed pleura rub against each other during inspiration.

**Rales:** Irregular crackling or bubbling sounds during inspiration. Wet rales are caused by fluid or infection in the alveoli. Dry rales are caused by chronic irritation or fibrosis.

**Rhonchi:** Humming, whistling, or snoring sounds during inspiration or expiration. They are caused by swelling, mucus, or a foreign body that partially obstructs the bronchi.

**Stridor:** High-pitched, harsh, crowing sound due to edema or obstruction in the trachea or larynx.

**Wheezes:** High-pitched whistling or squeaking sounds during inspiration or expiration. They are caused by extreme narrowing of the lumen due to bronchospasm from asthma.
adult respiratory distress syndrome (ARDS)

A severe infection, extensive burns, or injury to the lungs (aspiration of vomit or inhalation of chemical fumes) damage the alveoli (see Figure 4-9 ■). The alveoli are edematous (filled with fluid) and do not make surfactant; they collapse with each breath. Treatment: Oxygen therapy. Use of a respirator. Surfactant drug through an endotracheal tube. Treat the underlying cause.

Figure 4-9 ■ Adult respiratory distress syndrome.
The wall of each alveolus is edematous and filled with fluid. There is poor blood flow in the capillary around the alveolus with some blood clots. The capillary walls leak fluid and blood into the alveolus. Capillary blood coming back to the heart (and going to the rest of the body) does not contain enough oxygen.

Infant respiratory distress syndrome (RDS) develops in premature infants who produce too little surfactant because their lungs are not fully mature. There is nasal flaring (the nostrils flare with each breath to draw in more air), grunting (the larynx closes against the epiglottis to maintain pressure in the lungs and keep the alveoli from collapsing), and retractions. Sternal retractions bend the flexible breast bone inward. Intercostal retractions pull in the soft tissue and muscles between the ribs. It is also known as hyaline membrane disease (HMD).

Atelectasis

Incomplete expansion or collapse of part or all of a lung due to mucus, tumor, trauma, or a foreign body that blocks the bronchus. The lung is said to be atelectatic. It is also known as collapsed lung. This can develop postoperatively in patients who have shallow breathing and no cough reflex. It appears on a chest x-ray as a hazy, white patch. Treatment: Treat the underlying cause. A chest tube can be inserted to reinflate the lung.
Figure 4-11 ■ Postural drainage and percussion.

This child with cystic fibrosis is lying on a downward incline to promote mucus drainage. The respiratory therapist is using cupped hands to do chest percussion to shake loose the thick mucus in her lungs.

Did You Know?

In healthy persons, an increased level of carbon dioxide stimulates breathing. Patients with COPD have a constantly increased level of carbon dioxide, so they depend on a decreased level of oxygen (hypoxic drive) to stimulate them to take a breath. Oxygen therapy for COPD patients must be carefully controlled so that it does not take away the hypoxic drive.

**Figure 4-10 ■ Cystic fibrosis.**

The hand of a child with cystic fibrosis compared to a normal adult hand (beneath). Cyanosis and clubbing of the fingertips are common in cystic fibrosis. A low level of oxygen causes blood in the arteries to be bluish rather than bright red, and the skin color is cyanotic. The chronic lack of oxygen causes the fingertips and fingernails to grow abnormally.
<table>
<thead>
<tr>
<th>Word or Phrase</th>
<th>Description</th>
<th>Word Building</th>
</tr>
</thead>
</table>
| **empyema**   | Localized collection of *purulent* material (pus) in the thoracic cavity from an infection in the lungs. It is also known as *pyothorax*. Treatment: Antibiotic drugs or surgery to drain the pus. | *empyema* (EM-py-EE-mah)  
  *em-* in  
  *py/o-* pus  
  *-ema* condition  
  Add words to make a complete definition of *empyema*: Condition in (the lungs of) pus. |
|               |             | *purulent* (PYOOR-yoo-lent)  
  *purul/o-* pus  
  *-ent* pertaining to |
|               |             | *pyothorax* (PY-oh-THOR-aks)  
  *py/o-* pus  
  *-thorax* thorax (chest) |

**Word Alert**

**SOUND-ALIKE WORDS**

- **empysema**  
  (noun) Chronic, irreversibly damaged alveoli that are enlarged and trap air in the lungs.  
  *Example: Emphysema caused this patient to have a barrel chest.*

- **empyema**  
  (noun) Localized collection of pus in the thoracic cavity.  
  *Example: She will be started immediately on intravenous antibiotic drugs for her empyema.*

**influenza**

Acute viral infection of the upper and lower respiratory system. There is fever, severe muscle aches, and a cough. It is also known as the flu. It occurs most often in the fall and winter months. Influenza plus a secondary bacterial infection can cause pneumonia and death in older adults. Prevention: An annual flu shot. Treatment: Rest, analgesic drugs, and fluids. Antibiotic drugs for a secondary bacterial infection.

### Clinical Connections

**Pharmacology.** There have been influenza epidemics in the past that killed thousands of people. Today, the most deadly strain of influenza is swine flu (H1N1 strain). *(Note: For a discussion of flu shots, see the Clinical Connections feature box on page 186.)* The use of aspirin to relieve the symptoms of the flu can cause **Reye’s syndrome**. The reason for this is not known. There is a very high level of ammonia in the blood and brain, with vomiting, seizures, and liver failure; it is sometimes fatal. Prevention: Use of acetaminophen (Tylenol) instead of aspirin to treat the symptoms of any viral infection.

- **Reye** (RYE)  
  *syn-* together  
  *-drome* a running  
  The ending *-drome* contains the combining form *drom/o-* and the one-letter suffix *–e.*
## Legionnaire’s Disease

Severe, sometimes fatal, bacterial infection. There are flu-like symptoms, body aches, and fever, followed by severe pneumonia with liver and kidney degeneration. Treatment: Antibiotic drug that is effective against this bacterium.

### Legionella pneumophilia

Legionnaire’s disease was first identified in 1976 when many people at an American Legion convention in Philadelphia became sick. Physicians and epidemiologists from the Centers for Disease Control and Prevention (CDCP) were called in to investigate this unknown disease. It was caused by an air conditioning system contaminated by a bacterium that is attracted to the lungs. The bacterium was named *Legionella pneumophilia*.

### Lung Cancer

Cancerous tumor of the lungs that is more common in smokers (see Figure 4-12) than nonsmokers. Lung cancer destroys normal tissue as it spreads (see Figure 4-13). The different types of lung cancer are named for the characteristics of the original malignant cell or tissue: squamous cell carcinoma, adenocarcinoma, large cell carcinoma, small cell carcinoma, and oat cell carcinoma. Treatment: Surgery, chemotherapy, or radiation therapy.

### Did You Know?

Legionnaire’s disease was first identified in 1976 when many people at an American Legion convention in Philadelphia became sick. Physicians and epidemiologists from the Centers for Disease Control and Prevention (CDCP) were called in to investigate this unknown disease. It was caused by an air conditioning system contaminated by a bacterium that is attracted to the lungs. The bacterium was named *Legionella pneumophilia*.

<table>
<thead>
<tr>
<th>Word or Phrase</th>
<th>Description</th>
<th>Word Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legionnaire’s disease</td>
<td>Severe, sometimes fatal, bacterial infection. There are flu-like symptoms, body aches, and fever, followed by severe pneumonia with liver and kidney degeneration. Treatment: Antibiotic drug that is effective against this bacterium.</td>
<td>Legionnaire (LEE-jen-AIR)</td>
</tr>
<tr>
<td>Legionella pneumophilia</td>
<td>Lung; air</td>
<td>pneum/o- attraction to; fondness for</td>
</tr>
<tr>
<td>pneumophilia (NOO-moh-FIL-ee-ah)</td>
<td>-ia condition; state; thing</td>
<td></td>
</tr>
<tr>
<td>cancer (KAN-ser)</td>
<td>malignant (mah-LIG-nant)</td>
<td>malign/o- intentionally causing harm; cancer</td>
</tr>
<tr>
<td>-ant pertaining to</td>
<td>carcinoma (KAR-sih-NOH-mah)</td>
<td>carcin/o- cancer</td>
</tr>
<tr>
<td>-oma tumor; mass</td>
<td>adenocarcinoma (AD-eh-noh-KAR-sih-NOH-mah)</td>
<td>aden/o- gland</td>
</tr>
<tr>
<td>cancer</td>
<td>carcin/o- cancer</td>
<td>-oma tumor; mass</td>
</tr>
</tbody>
</table>

**Figure 4-12** ■ Tar deposits in the lung.

This section of lung tissue shows hundreds of large and small deposits of black tar from years of smoking. Cigarette tar also contains carcinogens that can cause cancer.

**Figure 4-13** ■ Lung cancer.

These are two autopsy specimens of lungs. The normal lung on the right has some small darkened areas due to air pollution or smoking. The lung on the left shows a large, white cancerous tumor in the base of the lung, as well as darkened areas throughout due to heavy smoking.
Constant exposure to inhaled particles causes pulmonary fibrosis, and the alveoli lose their elasticity. **Anthracosis** (coal miner’s lung or black lung disease) is caused by coal dust. **Asbestosis** is caused by asbestos fibers. **Pneumoconiosis** is a general word for any occupational lung disease caused by chronically inhaling some type of dust or particle. Treatment: Wear a filtering mask to prevent inhalation. Bronchodilator drugs and corticosteroid drugs.

**Clinical Connections**

**Public Health.** Sick building syndrome consists of symptoms such as headache; eye, nose, or throat irritation; cough; dizziness; difficulty concentrating; and fatigue. These are not related to any specific illness, and the symptoms subside or disappear shortly after a person leaves that building. Sick building syndrome is caused by inadequate ventilation coupled with indoor pollutants released by carpeting, adhesives, paint that contains volatile organic compounds (VOCs), copy machines, cleaning agents, etc.

- **anthracosis** (an-thrah-KOH-sis)
  - anthrac/o- coal
  - -osis condition; abnormal condition; process
- **asbestosis** (AS-bes-TOH-sis)
  - asbest/o- asbestos
  - -osis condition; abnormal condition; process
- **pneumoconiosis** (noo-moh-KOH-nee-Oh-sis)
  - pneum/o- lung; air
  - coni/o- dust
  - -osis condition; abnormal condition; process

**Pneumonia**

Infection of some or all of the lobes of the lungs (see Figure 4-14 ■). Fluid, microorganisms, and white blood cells fill the alveoli and air passages. There is difficulty breathing, with coughing and mucus production. Inflammation of the pleura causes pain on inspiration. Pneumonia is named according to its cause or its location in the lungs. Treatment: Antibiotic drugs for bacterial pneumonia. Oxygen therapy and mechanical ventilation, if needed.

**Figure 4-14 ■ Pneumonia.**

Compare the normal chest x-ray on the left with the chest x-ray on the right that shows a patchy gray-white area of pneumonia in the right upper and right middle lobes. Remember, when you look at the x-ray, the patient’s right lung corresponds to your left side.

<table>
<thead>
<tr>
<th>Word or Phrase</th>
<th>Description</th>
<th>Word Building</th>
</tr>
</thead>
</table>
| occupational lung diseases | Constant exposure to inhaled particles causes pulmonary fibrosis, and the alveoli lose their elasticity. Anthracosis (coal miner's lung or black lung disease) is caused by coal dust. Asbestosis is caused by asbestos fibers. Pneumoconiosis is a general word for any occupational lung disease caused by chronically inhaling some type of dust or particle. Treatment: Wear a filtering mask to prevent inhalation. Bronchodilator drugs and corticosteroid drugs. | anthracosis (an-thrah-KOH-sis)  
  - anthrac/o- coal  
  - -osis condition; abnormal condition; process  
  
  Add words to make a complete definition of anthracosis: abnormal condition (of the lungs from inhaling) coal (dust).  
  
  asbestosis (AS-bes-TOH-sis)  
  - asbest/o- asbestos  
  - -osis condition; abnormal condition; process  
  
  pneumoconiosis (noo-moh-KOH-nee-Oh-sis)  
  - pneum/o- lung; air  
  - coni/o- dust  
  - -osis condition; abnormal condition; process  

| pneumonia | Infection of some or all of the lobes of the lungs (see Figure 4-14 ■). Fluid, microorganisms, and white blood cells fill the alveoli and air passages. There is difficulty breathing, with coughing and mucus production. Inflammation of the pleura causes pain on inspiration. Pneumonia is named according to its cause or its location in the lungs. Treatment: Antibiotic drugs for bacterial pneumonia. Oxygen therapy and mechanical ventilation, if needed. | pneumonia (noo-MOH-nee-ah)  
  - pneumon/o- lung; air  
  - -ia condition; state; thing  

| aspiration pneumonia | Caused by foreign matter (chemicals, vomit, etc.) that is inhaled into the lungs | aspiration (AS-pih-RAY-shun)  
  - aspir/o- to breathe in; to suck in  
  - -ation a process; being or having |
<table>
<thead>
<tr>
<th>Word or Phrase</th>
<th>Description</th>
<th>Word Building</th>
</tr>
</thead>
</table>
| **bacterial pneumonia**| Pneumonia caused by bacteria                                                | **bacterial** (bak-TEER-ee-al)  
**bacteri/o**- bacterium  
-al pertaining to |
| **bronchopneumonia**   | Affects the bronchi, bronchioles, and alveoli in the lung                   | **bronch/o**- bronchus  
**pneumon/o**- lung; air  
-ia condition; state; thing |
| **double pneumonia**   | Involves both lungs                                                         |                                                                                |
| **lobar pneumonia**    | Affects part or all of one lobe of the lung. **Panlobar** pneumonia affects all of the lobes in one lung. | **lobar** (LOH-bar)  
**lob/o**- lobe of an organ  
-ar pertaining to  
**panlobar** (pan-LOH-bar)  
**pan**- all  
**lob/o**- lobe of an organ  
-ar pertaining to |
| **pneumococcal pneumonia** | Acute pneumonia caused by the bacterium *Streptococcus pneumoniae*. Prevention: Pneumococcal vaccine. | **pneumococcal** (NOO-moh-KAW-kal)  
**pneum/o**- lung; air  
**cocc/o**- spherical bacterium  
-al pertaining to |
| **Pneumocystis jiroveci pneumonia** | Severe pneumonia caused by the fungus *Pneumocystis jiroveci*. Most people are infected with this microorganism in childhood. It causes a mild infection, and then lies dormant in small cysts. In patients with AIDS, it emerges from the cysts and causes disease. It is known as an **opportunistic infection** because it waits for an opportunity to cause disease. Note: In the past, this disease was known as *Pneumocystis carinii* pneumonia (PCP). Treatment: Antifungal and antiprotozoal drugs. | **Pneumocystis jiroveci** (NOO-moh-SIS-tis YEE-roh-VET-zee)  
**opportunist/ic** (AWP-or-too-NIS-tik)  
**opportun/o**- well timed; taking advantage of an opportunity  
-istic pertaining to |
| **viral pneumonia**    | Pneumonia caused by a virus                                                 | **viral** (VY-ral)  
**vir/o**- virus  
-al pertaining to |
| **walking pneumonia**  | Mild form of pneumonia caused by the bacterium *Mycoplasma pneumoniae*. The patient does not feel well but can continue daily activities. |                                                                                |
| **pulmonary edema**    | Fluid (edema) collects in the alveoli. This is a result of backup of blood in the pulmonary circulation because of failure of the left side of the heart to adequately pump blood. There is dyspnea and orthopnea. Treatment: Correct the underlying heart failure. Oxygen therapy. | **edema** (eh-DEE-mah) |
severe acute respiratory syndrome (SARS)
Acute viral respiratory illness that can be fatal. There is fever, dyspnea, and cough, together with a history of travel in an airplane or close contact with another SARS patient. Chest x-ray shows pneumonia or adult respiratory distress syndrome. Treatment: Oxygen therapy and ventilator support. Antibiotic drugs are not effective against a viral illness.

pulmonary embolism
Blockage of a pulmonary artery or one of its branches by an embolus (see Figure 4-15). A patient on prolonged bedrest or one with an injury to the leg can develop a blood clot in the leg (deep vein thrombosis), or a fractured bone can release a fat globule. The embolus (blood clot or fat globule) travels in the circulatory system to a pulmonary artery where it is trapped and blocks the blood flow. There is decreased oxygenation of the blood and dyspnea. A large pulmonary embolus can be fatal. Treatment: Oxygen therapy, thrombolytic drugs (to dissolve a blood clot), and anticoagulant drugs (to prevent more blood clots from forming).

tuberculosis (TB)
Lung infection caused by the bacterium Mycobacterium tuberculosis and spread by airborne droplets and coughing. If the patient’s immune system is strong, the bacteria remain dormant and cause no symptoms. Otherwise, the bacteria multiply, producing tubercles (soft nodules of necrosis) in the lungs. There is fever, cough, weight loss, night sweats, and hemoptysis (coughing up blood). When this bacterium is stained in the laboratory, it holds an acid stain, and so it is known as an acid-fast bacillus (AFB). Treatment: The waxy, external coating around this bacterium makes it resistant to regular antibiotic drugs. Several antitubercular drugs are used in combination for 9 months to treat tuberculosis.
## Pleura and Thorax

<table>
<thead>
<tr>
<th>Word or Phrase</th>
<th>Description</th>
<th>Word Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>hemothorax</td>
<td>Presence of blood in the thoracic cavity, usually from trauma. Treatment: Thoracentesis or insertion of a chest tube to remove blood and fluid.</td>
<td>hemothorax (hee-moh-THOR-aks) hem/o- blood -thorax thorax (chest)</td>
</tr>
<tr>
<td>pleural effusion</td>
<td>Accumulation of fluid in the pleural space due to inflammation or infection of the pleura and lungs. Treatment: Antibiotic drugs or thoracentesis to remove the fluid.</td>
<td>effusion (ee-FYOO-zhun) effus/o- a pouring out -ion action; condition</td>
</tr>
<tr>
<td>pleurisy</td>
<td>Inflammation or infection of the pleura due to pneumonia, trauma, or tumor. It is also known as pleuritis. The inflamed layers of pleura rub against each other, causing pain on inspiration. The rubbing sound heard through the stethoscope is a pleural friction rub. A patient with pleurisy is said to be pleuritic. Treatment: Correct the underlying cause.</td>
<td>pleurisy (PLOOR-ih-see) pleur/o- pleura (lung membrane) -isy condition of inflammation or infection</td>
</tr>
<tr>
<td>pneumothorax</td>
<td>Large volume of air in the pleural space. This increasingly separates the two layers of the pleura and compresses or collapses the lung. This is caused by a penetrating injury, or a spontaneous pneumothorax can occur when alveoli rupture from lung disease. Note: Air within the lung is normal; air within the pleural space is not. Treatment: Thoracentesis or insertion of a chest tube to remove the air.</td>
<td>pneumothorax (NOO-moh-THOR-aks) pneum/o- lung; air -thorax thorax (chest)</td>
</tr>
</tbody>
</table>

## Respiration

<table>
<thead>
<tr>
<th>Word or Phrase</th>
<th>Description</th>
<th>Word Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>apnea</td>
<td>Brief or prolonged absence of spontaneous respirations due to respiratory failure or respiratory arrest. In premature infants, the immature central nervous system fails to maintain a consistent respiratory rate, and there are long pauses between periods of regular breathing. Middle-aged, obese patients who snore excessively have obstructive sleep apnea. They stop breathing as many as 30 times an hour during the night because of obstruction of the airway (by the soft palate or obesity of the neck), and then take a gasping breath that often awakens them. This causes sleep deprivation, fatigue, and difficulty concentrating during the day. Patients having an episode of apnea are said to be apneic. Treatment: Home apnea monitors for infants. A continuous positive airway pressure (CPAP) apparatus on the nose to give positive pressure to keep the airway open.</td>
<td>apnea (AP-nee-ah) a- away from; without -pnea breathing</td>
</tr>
<tr>
<td>bradypnea</td>
<td>Abnormally slow rate of breathing (less than 10 breaths per minute). This can be caused by a chemical imbalance in the blood or by neurologic damage that affects the respiratory centers of the brain. Treatment: Correct the underlying cause.</td>
<td>bradypnea (bRAYD-ip-NEE-ah) brady- slow -pnea breathing</td>
</tr>
<tr>
<td>cough</td>
<td>Protective mechanism to forcefully expel accidentally inhaled food, irritating particles (smoke, dust), or internally produced mucus. A cough may be nonproductive or productive of sputum. Expectoration is coughing up sputum from the lungs. Hemoptysis is coughing up blood-tinged sputum. Treatment: Expectorant drugs for a productive cough, antitussive drugs for a nonproductive cough. Correct the underlying cause.</td>
<td>expectoration (ek-sper-toh-RAY-shun) ex- out; away from pector/o- chest -ation a process; being or having hemoptysis (hee-MAWP-tih-sis) hem/o- blood -ptysis abnormal condition of coughing up</td>
</tr>
</tbody>
</table>
dyspnea
Difficult, labored, or painful respirations due to lung disease. It is also known as shortness of breath (SOB). Dyspnea on exertion (DOE) occurs after brief activity in patients with severe chronic obstructive pulmonary disease (COPD). Paroxysmal nocturnal dyspnea (PND) is shortness of breath that occurs at night (nocturnal) because fluid builds up in the lungs while the patient is lying down. Patients are said to be dyspneic.
Treatment: Sleeping propped up on pillows or in a chair. Oxygen therapy. Correct the underlying cause.

orthopnea
The need to be propped in an upright or semi-upright position in order to breathe and sleep comfortably. Dyspnea and congestion occur if the patient lies down. The patient is said to be orthopneic. The severity of the orthopnea is expressed as the number of pillows that are needed (i.e., two-pillow orthopnea). Treatment: Oxygen therapy. Correct the underlying cause.

tachypnea
Abnormally rapid rate of breathing (greater than 20 breaths per minute in adults), that is caused by lung disease. The patient is said to be tachypneic. Treatment: Oxygen therapy. Correct the underlying cause.

Oxygen and Carbon Dioxide Levels

anoxia
Complete lack of oxygen in the arterial blood and body tissues. It is caused by a lack of oxygen in the inhaled air or by an obstruction that prevents oxygen from reaching the lungs. The patient is said to be anoxic. Treatment: Oxygen therapy. Correct the underlying cause.

asphyxia
An abnormally high level of carbon dioxide and an abnormally low level of oxygen. Asphyxia can occur in a fetus during the birth process or at any age if a person chokes, drowns, or suffocates. Treatment: Cardiopulmonary resuscitation.

Clinical Connections

Obstetrics. Birth asphyxia occurs when the fetus in the uterus does not get enough oxygen through the umbilical cord and placenta before or during birth. This can be caused by premature separation of the placenta from the uterine wall, an umbilical cord that is wrapped tightly around the neck, or an umbilical cord that is compressed by the weight of the fetus during delivery.

Sudden infant death syndrome (SIDS). is an acute event in which an apparently healthy infant under 1 year of age suddenly dies. The cause is unknown; it may be due to respiratory arrest from vomiting and aspirating stomach contents, from asphyxiation from soft bedding blocking the nose, from sleep apnea, or from an imbalance of neurotransmitters in the brain. Parents are cautioned to position babies on their backs (or their sides) to sleep.
**cyanosis**

Bluish-gray discoloration of the skin because of a very low level of oxygen and a very high level of carbon dioxide in the blood and tissues. It can be seen around the mouth (circumoral cyanosis) or in the nailbeds (see Figure 4-10). The patient is said to be cyanotic. Treatment: Oxygen therapy. Correct the underlying cause.

**Word Building**
- **cyanosis** *(sy-ah-NOH-sis)*
  - cyan/o- blue
  - -osis condition; abnormal condition; process
- **circumoral** *(sir-kum-OR-al)*
  - circum- around
  - or/o- mouth
  - -al pertaining to
- **cyanotic** *(sy-ah-NAWT-ik)*
  - cyan/o- blue
  - -tic pertaining to

**Clinical Connections**

**Forensic Science.** When a person drowns or suffocates, there is a high level of carbon dioxide (CO₂) in the blood, and the skin shows cyanosis. However, when a person dies in a fire or from inhaling the fumes from car exhaust or a faulty space heater, there is a high level of carbon monoxide (CO) in the blood. Carbon monoxide binds to the same site on the hemoglobin molecule as oxygen does, and the hemoglobin is unable to carry any oxygen. Carbon monoxide poisoning causes a characteristic cherry red skin color.

**Public Health.** One new car in 1960 generated as much air pollution as 20 new cars today. According to the Foundation for Clean Air Progress, air pollution in the United States has decreased dramatically since 1970. The Air Quality Index is a numeral scale that rates the quality of the air daily. An AQI of 0–50 is good, over 100 is unhealthy for sensitive people, and over 300 is hazardous for everyone. California was the first of 23 states to ban smoking in public places such as restaurants and bars, because even secondhand smoke is a carcinogen according to the Environmental Protection Agency. In children, exposure to it is linked to asthma, respiratory infections, and middle ear infections.

**hypercapnia**

Very high level of carbon dioxide (CO₂) in the arterial blood. Treatment: Oxygen therapy. Correct the underlying cause.

**hypoxemia**

Very low level of oxygen in the arterial blood. **Hypoxia** is a very low level of oxygen in the cells. The patient is said to be hypoxic. Treatment: Oxygen therapy. Correct the underlying cause.

**Word Building**
- **hypercapnia** *(HY-per-KAP-nee-ah)*
  - hyper- above; more than normal
  - capn/o- carbon dioxide
  - -ia condition; state; thing
- **hypoxemia** *(hy-PAWK-SEE-mee-ah)*
  - hypo- below; deficient
  - ox/o- oxygen
  - -emia condition of the blood; substance in the blood
- **hypoxia** *(hy-PAWK-see-ah)*
  - hypo- below; deficient
  - ox/o- oxygen
  - -ia condition; state; thing
- **hypoxic** *(hy-PAWK-sik)*
Laboratory and Diagnostic Procedures

<table>
<thead>
<tr>
<th>Word or Phrase</th>
<th>Description</th>
<th>Word Building</th>
</tr>
</thead>
</table>
| arterial blood gases (ABG) | Blood test to measure the partial pressure (P) of the gases oxygen (PO₂) and carbon dioxide (PCO₂) in arterial blood. The pH, how acidic or alkaline the blood is, is also measured. The higher the level of carbon dioxide, the more acidic the blood and the lower the pH. | arterial (ar-TEER-eal)  
  arteri/o-  
  -al pertaining to |
| carboxyhemoglobin        | Blood test to measure the level of carbon monoxide in the blood of patients exposed to fires or fumes in unventilated spaces. Carbon monoxide is carried by hemoglobin as carboxyhemoglobin. A blood level above 50% is fatal. | carboxyhemoglobin (kar-BWAK-see-HEE-moh-gloh-bin)  
  carboxy/- carbon monoxide  
  hem/o- blood  
  glob/o- shaped like a globe; comprehensive  
  -in a substance |
| oximetry                | Diagnostic procedure in which an oximeter, a small, noninvasive clip device, is placed on the patient’s index finger or earlobe to measure the degree of oxygen saturation of the blood (see Figure 4-16). It emits light waves that penetrate the skin and are absorbed or reflected by saturated hemoglobin (that is bound to oxygen) versus unsaturated hemoglobin. The oximeter calculates and displays a number for the oxygen saturation of the blood. It does not measure the CO₂ level. Some oximeters also measure the pulse rate; they are known as pulse oximeters. | oximetry (awk-SIM-eh-tree)  
  ox/i- oxygen  
  -metry process of measuring |

Figure 4-16  Oximeter.
This device is used in ambulances and in hospitals (at the patient’s bedside) to provide a quick and accurate readout of the degree of oxygen saturation of the patient’s blood.
pulmonary function test (PFT)

Diagnostic procedure to measure the capacity of the lungs and the volume of air during inhalation and exhalation (see Figure 4-17). The FVC (forced vital capacity) measures the amount of air that can be forcefully exhaled from the lungs after the deepest inhalation. The FEV₁ (forced expiratory volume in 1 second) measures the volume of air that can be forcefully exhaled during the first second of measuring the FVC. Spirometry measures the FEV₁ and FVC and produces a tracing on a graph.

spirometry (spih-RAWM-eh-tree)
spir/o- breathe; a coil
-metry process of measuring

sputum culture and sensitivity (C&S)

Diagnostic test to identify which bacterium is causing a pulmonary infection and to determine its sensitivity to various antibiotic drugs (see Figure 4-18).

sensitivity (SEN-sih-TIV-ih-tee)
sensitiv/o- affected by; sensitive to
-ity state; condition

Figure 4-17 Pulmonary function test.
This child who has asthma is having a pulmonary function test. The blue clip on his nose ensures that air only flows in and out of his mouth so that the volume of air in his lungs can be accurately measured.

Figure 4-18 Culture and sensitivity.
Paper disks containing various antibiotic drugs are placed on a culture plate. The plate contains a growth medium that has been swabbed with a specimen from the patient (mucus, pleural fluid, etc.). If the bacteria in the specimen are resistant to that antibiotic drug, there will only be a small zone of inhibition (no growth) around that disk. If the bacteria are sensitive to that antibiotic drug, there will be a medium or large zone of inhibition around that disk, and the physician may prescribe that drug to treat the patient’s infection.

tuberculosis tests

Tests to determine if a patient has been exposed to tuberculosis. The tine test is a screening test that uses a four-pronged device (similar to the tines on a fork) to puncture the skin and introduce PPD (purified protein derivative), part of the bacterium *Mycobacterium tuberculosis*. The Mantoux test is a diagnostic test that uses an intradermal injection of PPD. A raised skin reaction after 48 to 72 hours indicates a prior exposure to tuberculosis with antibodies to the tuberculosis bacterium. A positive Mantoux test is followed up with a chest x-ray to confirm whether or not the patient has active tuberculosis. A sputum specimen can be smeared on a glass slide, stained, and examined under the microscope to look for the acid-fast bacilli of *Mycobacterium tuberculosis*.

Mantoux (man-TOO)
### Radiology and Nuclear Medicine Procedures

<table>
<thead>
<tr>
<th>Word or Phrase</th>
<th>Description</th>
<th>Word Building</th>
</tr>
</thead>
</table>
| chest radiography     | Radiologic procedure that uses x-rays to create an image of the lungs. It is also known as a chest x-ray (CXR). In an AP (anteroposterior) chest x-ray, the x-rays enter the patient’s body through the anterior chest and then enter the x-ray plate. In a PA (posteroanterior) chest x-ray, the x-rays enter through the patient’s back (see Figure 2-5). In a lateral chest x-ray, the x-rays enter through the patient’s side. PA and lateral chest x-rays are often done during the same examination. | radiography (RAY-dee-AWG-rah-fee)  
|                       | radi/o- radius (forearm bone); x-rays; radiation  
|                       | -graphy process of recording                                                                                                                                                                                |
| CT scan and MRI scan  | Radiologic procedures that scan a narrow slice of tissue and create an image. This process is known as tomography. A computer then assembles all of the "slices" into a three-dimensional image. A CT scan (which uses x-rays) and an MRI scan (which uses a magnetic field) are better at showing soft tissue structures than is radiography. | tomography (toh-MAWG-rah-fee)  
|                       | tom/o- cut; slice; layer  
|                       | -graphy process of recording                                                                                                                                                                                |
| lung scan             | Nuclear medicine procedure that uses inhaled radioactive gas to show air flow (ventilation) in the lungs. Areas of decreased uptake ("cold spots") indicate pneumonia, atelectasis, or pleural effusion. A radioactive solution is given intravenously for the perfusion part of the scan. Areas of decreased uptake indicate poor blood flow to that part of the lung (and possible pulmonary embolus). It is also known as a ventilation-perfusion (V/Q) scan. | ventilation (VEN-tih-LAY-shun)  
|                       | venti/o- movement of air  
|                       | -ation a process; being or having  
|                       | perfusion (per-FYOO-zhun)  
|                       | per- through; throughout  
|                       | fus/o- pouring  
|                       | -ion action; condition                                                                                                                                                                                      |
Chapter 4 | Pulmonology

Medical and Surgical Procedures

### Medical Procedures

<table>
<thead>
<tr>
<th>Word or Phrase</th>
<th>Description</th>
<th>Word Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>auscultation and percussion</td>
<td>Procedure that uses a stethoscope to listen to breath sounds (see Figures 2-20 and 4-21). Percussion uses the finger of one hand to tap over the finger of the other hand that is spread across the patient’s back over a lobe of the lung. After a few taps, the hand is moved over another lobe. The sound tells the physician if the lung is clear or if there is fluid or a tumor present (see Figure 2-21).</td>
<td>auscultation (AWS-kul-TAY-shun)&lt;br&gt;auscult/o-listening&lt;br&gt;-ation a process; being or having</td>
</tr>
<tr>
<td>cardiopulmonary resuscitation (CPR)</td>
<td>Procedure to ventilate the lungs and artificially circulate the blood if the patient has stopped breathing and the heart has stopped beating. Mouth-to-mouth resuscitation involves forcing air into the victim’s lungs; chest compressions pump blood through the heart.</td>
<td>cardiopulmonary (KAR-dee-oh-PUL-moh-NAIR-ee)&lt;br&gt;cardi/o-heart&lt;br&gt;pulmon/o-lung&lt;br&gt;-ary pertaining to resuscitation (ree-sus-ih-TAY-shun)&lt;br&gt;resuscit/o-revive; raise up again&lt;br&gt;-ation a process; being or having</td>
</tr>
</tbody>
</table>

### Clinical Connections

**Public Health.** Many persons with chronic health problems wear a Medic Alert emblem bracelet or necklace. The back of the emblem describes their disease or condition so that this information is available in an emergency even if they are unconscious.
**endotracheal intubation**

Procedure in which an endotracheal tube (ETT) is inserted. A lighted laryngoscope helps visualize the vocal cords. The tube goes from outside the mouth, between the vocal cords of the larynx, and into the trachea. This establishes an airway for a patient who is not breathing or needs a ventilator (see Figure 4-19 ■). This procedure is performed by paramedics in the field, by physicians in the emergency department, or by anesthesiologists in the operating room prior to surgical procedures. Alternatively, a nasotracheal tube that goes from outside the nose, between the vocal cords, and into the trachea can be used.

![Figure 4-19 ■ Endotracheal intubation.](image)

A laryngoscope is used to visualize the vocal cords prior to insertion of an endotracheal tube. The endotracheal tube is positioned in the trachea, just above the bronchi. A small balloon at the tip of the tube is inflated to hold the tube in place, and the external part of the tube is taped to the patient’s cheek.

<table>
<thead>
<tr>
<th>Word or Phrase</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heimlich maneuver</td>
<td>Procedure to assist a choking victim with an airway obstruction. The rescuer stands behind the victim and places a fist on the victim’s abdominal wall just below the diaphragm and, with both hands, gives a sudden push inward and upward. This generates a burst of air that pushes the obstruction into the mouth where it can be expelled.</td>
</tr>
<tr>
<td>incentive spirometer</td>
<td>Medical device to encourage patients to breathe deeply to prevent atelectasis. A spirometer is a portable plastic device with a mouthpiece and balls that move as the patient inhales forcefully.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Word Building</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>endotracheal</strong> (EN-doh-TRAY-kee-al)</td>
</tr>
<tr>
<td><em>endo-</em> innermost; within</td>
</tr>
<tr>
<td><em>trache/o-</em> trachea (windpipe)</td>
</tr>
<tr>
<td>-al pertaining to</td>
</tr>
<tr>
<td><strong>intubation</strong> (in-too-BAY-shun)</td>
</tr>
<tr>
<td><em>in-</em> in; within; not</td>
</tr>
<tr>
<td><em>tub/o-</em> tube</td>
</tr>
<tr>
<td>-ation a process; being or having</td>
</tr>
<tr>
<td><strong>laryngoscope</strong> (lah-RING-goh-skohp)</td>
</tr>
<tr>
<td><em>laryng/o-</em> larynx (voice box)</td>
</tr>
<tr>
<td>-scope instrument used to examine</td>
</tr>
<tr>
<td><strong>nasotracheal</strong> (NAY-soh-TRAY-kee-al)</td>
</tr>
<tr>
<td><em>nas/o-</em> nose</td>
</tr>
<tr>
<td><em>trache/o-</em> trachea (windpipe)</td>
</tr>
<tr>
<td>-al pertaining to</td>
</tr>
</tbody>
</table>

**spirometer** (spih-RAWM-eh-ter) |
| *spir/o-* breathe; a coil |
| -meter instrument used to measure |
**Oxygen Therapy**

Procedure to provide additional oxygen to patients with pulmonary disease. Room air is 21% oxygen. A patient can need amounts of oxygen ranging from 22% to 100%. Oxygen is delivered to the patient via a **nasal cannula** (see Figure 4-20 ■) or a face mask. An infant can receive oxygen through a rigid plastic hood placed over the head or in an oxygen tent. Oxygen is drying, and so patients who need a high flow of oxygen or prolonged oxygen therapy receive humidified oxygen (bubbled through water). A patient who requires respiratory assistance as well as oxygen is placed on a **ventilator (respirator)**, a mechanical device that breathes for the patient or assists with some breaths. Ventilators can provide up to 100% oxygen, as well as pressure to keep the lungs from collapsing. An **Ambu bag** is a hand-held device that is used to manually breathe for the patient on a temporary basis. It is attached to a face mask or to an endotracheal tube and is squeezed to force air into the lungs (see Figure 4-21 ■). The patient is said to be being “bagged.”

<table>
<thead>
<tr>
<th>Word or Phrase</th>
<th>Description</th>
<th>Word Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>oxygen therapy</td>
<td>Procedure to provide additional oxygen to patients with pulmonary disease. Room air is 21% oxygen. A patient can need amounts of oxygen ranging from 22% to 100%. Oxygen is delivered to the patient via a <strong>nasal cannula</strong> (see Figure 4-20 ■) or a face mask. An infant can receive oxygen through a rigid plastic hood placed over the head or in an oxygen tent. Oxygen is drying, and so patients who need a high flow of oxygen or prolonged oxygen therapy receive humidified oxygen (bubbled through water). A patient who requires respiratory assistance as well as oxygen is placed on a <strong>ventilator (respirator)</strong>, a mechanical device that breathes for the patient or assists with some breaths. Ventilators can provide up to 100% oxygen, as well as pressure to keep the lungs from collapsing. An <strong>Ambu bag</strong> is a hand-held device that is used to manually breathe for the patient on a temporary basis. It is attached to a face mask or to an endotracheal tube and is squeezed to force air into the lungs (see Figure 4-21 ■). The patient is said to be being “bagged.”</td>
<td><strong>cannula (KAN-yoo-lah)</strong>&lt;br&gt;<strong>ventilator (VEN-tih-LAY-tor)</strong>&lt;br&gt;ventil/o- movement of air&lt;br&gt;-ator person or thing that produces or does&lt;br&gt;<strong>respirator (RES-pih-RAV-tor)</strong>&lt;br&gt;re- again and again; backward; unable to&lt;br&gt;spir/o- breathe; a coil&lt;br&gt;-ator person or thing that produces or does&lt;br&gt;<strong>Ambu (AM-boo)</strong></td>
</tr>
</tbody>
</table>

---

**Figure 4-20 ■ Nasal cannula.**

This patient is receiving oxygen therapy through a nasal cannula, a plastic tube with two short, flexible prongs that rest just inside the nostrils. A nasal cannula can provide an oxygen concentration up to 45%.

**Figure 4-21 ■ Endotracheal tube and Ambu bag.**

This infant in the pediatric intensive care unit has an endotracheal tube to assist with breathing. The nurse on the left is using a stethoscope to auscultate the breath sounds in the infant’s right lung. The other nurse is squeezing a blue Ambu bag to breathe for the infant until the endotracheal tube is reconnected to the ventilator. The left chest is bandaged where a chest tube was inserted, and the yellow drainage tube for the chest tube is at the bottom right. The infant’s pink skin color shows that the level of oxygen in the blood is adequate because of treatment with the ventilator and oxygen.

**Vital Signs**

Procedure during a physical examination in which the temperature, pulse, respirations (TPR), and blood pressure (BP) are measured. The respirations are measured for 1 minute by counting each rise and fall of the thorax as one breath. An assessment of pain is often done as well as the fifth vital sign.
### Surgical Procedures

<table>
<thead>
<tr>
<th>Word or Phrase</th>
<th>Description</th>
<th>Word Building</th>
</tr>
</thead>
</table>
| bronchoscopy      | Procedure that uses a lighted **bronchoscope** inserted through the mouth and larynx to examine the trachea and bronchi. Attachments on the bronchoscope can remove foreign bodies, suction thick mucus, or perform a biopsy. | **bronchoscopy** (brong-KAWS-koh-pee)  
  **broncho/o-** bronchus  
  -**scopy** process of using an instrument to examine  
  **bronchoscope** (BRONG-koh-skohp)  
  **broncho/o-** bronchus  
  -**scope** instrument used to examine |
| chest tube insertion | Procedure that inserts a plastic tube between the ribs and into the thoracic cavity to remove accumulated air or blood due to trauma or infection. The tube is connected to a container (to measure the drainage) and to a suction device. A chest tube is used to treat pneumothorax, pyothorax, or hemothorax. |              |
| lung resection    | Procedure to remove part or all of a lung. A wedge resection removes a small wedge-shaped piece of lung tissue. A segmental resection removes a large piece or a segment of a lobe. A **lobectomy** removes an entire lobe (see Figure 4-22 ■). A **pneumonectomy** removes an entire lung. A lung resection is done as a biopsy procedure or to treat severe emphysema or lung cancer. | **resection** (ree-SEK-shun)  
  **resect/o-** to cut out; remove  
  -**ion** action; condition  
  **lobectomy** (loh-BEK-toh-mee)  
  **lob/o-** lobe of an organ  
  -**ectomy** surgical excision  
  **pneumonectomy** (NOO-moh-NEK-toh-mee)  
  **pneumon/o-** lung; air  
  -**ectomy** surgical excision |

**Figure 4-22 ■ Lobectomy.**

A surgical stapler is used to staple and seal spongy lung tissue and the bronchus. Then the emphysematous right upper lobe is removed (resected). The remaining lung tissue has more room to normally expand with each breath.

| thoracentesis    | Procedure that uses a needle and a vacuum container to remove pleural fluid from the pleural space. It is used to treat a pleural effusion or obtain fluid for the diagnosis of lung cancer. It is also known as a **thoracocentesis**. | **thoracentesis** (THOR-ah-sen-TEE-sis)  
  **thorac/o-** thorax (chest)  
  -**centesis** procedure to puncture  
  Note: The duplicated c is deleted. |
| thoracotomy      | Incision into the thoracic cavity. This is the first step of a surgical procedure involving the thoracic cavity and lungs. | **thoracotomy** (THOR-ah-KAW-toh-mee)  
  **thorac/o-** thorax (chest)  
  -**otomy** process of cutting or making an incision |
This procedure begins with an incision into the trachea (tracheotomy) to create an opening. A tracheostomy tube is then inserted to keep the opening from closing (see Figure 4-23). A tracheostomy provides temporary or permanent access to the lungs in patients who need respiratory support, usually with a ventilator. The patient is said to have a “trach.”

**Figure 4-23 Tracheostomy.**

This patient has a permanent tracheostomy. The tracheostomy tube has a wide flange around it with slots where cotton tape can be inserted and tied around the patient’s neck to secure the tube in the trachea.

<table>
<thead>
<tr>
<th>Word or Phrase</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>tracheostomy</td>
<td>This procedure begins with an incision into the trachea (tracheotomy) to create an opening. A tracheostomy tube is then inserted to keep the opening from closing (see Figure 4-23). A tracheostomy provides temporary or permanent access to the lungs in patients who need respiratory support, usually with a ventilator. The patient is said to have a “trach.”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Word Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>tracheotomy</td>
</tr>
<tr>
<td>trache/o-</td>
</tr>
<tr>
<td>-stomy</td>
</tr>
<tr>
<td>tracheotomy</td>
</tr>
<tr>
<td>trache/o-</td>
</tr>
<tr>
<td>-tomy</td>
</tr>
</tbody>
</table>
# Drug Categories

These categories of drugs are used to treat respiratory diseases and conditions. The most common generic and trade name drugs in each category are listed.

<table>
<thead>
<tr>
<th>Category</th>
<th>Indication</th>
<th>Examples</th>
<th>Word Building</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>antibiotic drugs</strong></td>
<td>Treat respiratory infections caused by bacteria. Antibiotic drugs are not effective against viral respiratory infections.</td>
<td>ampicillin (Principen), amoxicillin (Amoxil), ciprofloxacin (Cipro), ceftriaxone (Rocephin)</td>
<td>antibiotic (AN-tee-by-AWT-ik) (AN-tee-by-AWT-ik) anti- against bi/o- life; living organisms; living tissue -tic pertaining to</td>
</tr>
<tr>
<td><strong>antitubercular drugs</strong></td>
<td>Treat tuberculosis. Several of these drugs must be used together in combination to be effective.</td>
<td>isoniazid (INH), ethambutol (Myambutol), rifampin (Rifadin)</td>
<td>antitubercular (AN-tee-too-BER-kyoo-lar) anti- against tubercul/o- nodule; tuberculosis -ar pertaining to</td>
</tr>
<tr>
<td><strong>antitussive drugs</strong></td>
<td>Suppress the cough center in the brain. They are used to treat chronic bronchitis and nonproductive coughs. Some of these contain a narcotic drug.</td>
<td>dextromethorphan (Robitussin), hydrocodone (Hycodan)</td>
<td>antitussive (AN-tee-TUS-iv) anti- against tuss/o- cough -ive pertaining to</td>
</tr>
<tr>
<td><strong>antiviral drugs</strong></td>
<td>Prevent and treat influenza virus infection in at-risk patients with asthma or lung disease.</td>
<td>oseltamivir (Tamiflu)</td>
<td>antiviral (AN-tee-VY-ral) anti- against vir/o- virus -al pertaining to</td>
</tr>
<tr>
<td><strong>bronchodilator drugs</strong></td>
<td>Dilate constricted airways by relaxing the smooth muscles that surround the bronchioles. They are used to treat asthma, COPD, emphysema, and cystic fibrosis. They are given orally or inhaled through a metered-dose inhaler (MDI) (see Figure 4-24 ■).</td>
<td>albuterol (Proventil), salmeterol (Serevent), theophylline (Bronkodyl)</td>
<td>bronchodilator (BRONG-koh-DY-lay-tor) bronch/o- bronchus dilat/o- dilate; widen -or person or thing that produces or does</td>
</tr>
</tbody>
</table>

![Figure 4-24](image)

**Figure 4-24 ■ Metered-dose inhaler.**

A metered-dose inhaler (MDI) automatically delivers a premeasured dose of a bronchodilator drug or corticosteroid drug into the lungs as the patient inhales through the mouth. The dose is prescribed as the number of metered sprays or puffs.
Chapter 4 | Pulmonology

Clinical Connections

Public Health. Flu shots are given to prevent influenza. Each February, the Centers for Disease Control and Prevention (CDCP) selects those strains of influenza that are most prevalent in Asia and other parts of the world to include in the flu vaccine that will be offered in the United States the following fall before the start of flu season. Flu viruses mutate constantly, and so the influenza vaccine must be reformulated every year. Persons who get flu shots can still get the flu from other strains of influenza not included in the flu vaccine. The concern about a possible widespread epidemic and deaths from swine flu (H1N1 strain) has resulted in a massive public vaccination program to prevent infection from this specific strain of virus.

<table>
<thead>
<tr>
<th>Category</th>
<th>Indication</th>
<th>Examples</th>
<th>Word Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>corticosteroid drugs</td>
<td>Block the immune system from causing inflammation in the lung. They are used to treat asthma and COPD. They are given by a metered-dose inhaler, orally, or intravenously.</td>
<td>fluticasone (Flovent), mometasone (Asmanex), prednisolone (Oropred), prednisone (Deltasone), triamcinolone (Azmacort)</td>
<td>corticosteroid (kor-tih-koh-STAIR-oyd)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>cortico- cortex (outer region) steroid</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Corticosteroids are hormones secreted by the cortex (outer region) of the adrenal glands; they have a powerful, anti-inflammatory effect. Corticosteroid drugs have this same effect.</td>
</tr>
<tr>
<td>expectorant drugs</td>
<td>Reduce the thickness of sputum so that it can be coughed up. They are used to treat productive coughs.</td>
<td>guaifenesin (Mucinex)</td>
<td>expectorant (ek-SPEK-toh-rant) ex- out; away from pector/o- chest -ant pertaining to</td>
</tr>
<tr>
<td>leukotriene receptor blocker drugs</td>
<td>Block leukotriene, which causes inflammation and edema. They are used to treat asthma.</td>
<td>montelukast (Singulair)</td>
<td>leukotriene (loo-koh-TRY-een)</td>
</tr>
<tr>
<td>mast cell stabilizer drugs</td>
<td>Stabilize mast cells and prevent them from releasing histamine that causes bronchospasm during an allergic reaction. They are used to treat asthma.</td>
<td>cromolyn (Intal)</td>
<td></td>
</tr>
</tbody>
</table>

## Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABG</td>
<td>arterial blood gases</td>
</tr>
<tr>
<td>AFB</td>
<td>acid-fast bacillus</td>
</tr>
<tr>
<td>A&amp;P</td>
<td>auscultation and percussion</td>
</tr>
<tr>
<td>AP</td>
<td>anteroposterior (view on chest x-ray)</td>
</tr>
<tr>
<td>ARDS</td>
<td>adult respiratory distress syndrome; acute respiratory distress syndrome</td>
</tr>
<tr>
<td>BS</td>
<td>breath sounds</td>
</tr>
<tr>
<td>C&amp;S</td>
<td>culture and sensitivity</td>
</tr>
<tr>
<td>CF</td>
<td>cystic fibrosis</td>
</tr>
<tr>
<td>CO</td>
<td>carbon monoxide</td>
</tr>
<tr>
<td>CO₂</td>
<td>carbon dioxide</td>
</tr>
<tr>
<td>COPD</td>
<td>chronic obstructive pulmonary disease</td>
</tr>
<tr>
<td>CPAP</td>
<td>continuous positive airway pressure</td>
</tr>
<tr>
<td>CPR</td>
<td>cardiopulmonary resuscitation</td>
</tr>
<tr>
<td>CXR</td>
<td>chest x-ray</td>
</tr>
<tr>
<td>DOE</td>
<td>dyspnea on exertion</td>
</tr>
<tr>
<td>ETT</td>
<td>endotracheal tube</td>
</tr>
<tr>
<td>FEV₁</td>
<td>forced expiratory volume (in one second)</td>
</tr>
<tr>
<td>FIO₂</td>
<td>fraction (percentage) of inspired oxygen</td>
</tr>
<tr>
<td>FVC</td>
<td>forced vital capacity</td>
</tr>
<tr>
<td>HMD</td>
<td>hyaline membrane disease</td>
</tr>
<tr>
<td>LLL</td>
<td>left lower lobe (of the lung)</td>
</tr>
<tr>
<td>LUL</td>
<td>left upper lobe (of the lung)</td>
</tr>
<tr>
<td>MDI</td>
<td>metered-dose inhaler</td>
</tr>
<tr>
<td>O₂</td>
<td>oxygen</td>
</tr>
<tr>
<td>PA</td>
<td>posteroanterior (view on chest x-ray)</td>
</tr>
<tr>
<td>PCO₂</td>
<td>partial pressure of carbon dioxide (also pCO₂)</td>
</tr>
<tr>
<td>PCP*</td>
<td><em>Pneumocystis carinii pneumonia</em> pulmonary function test</td>
</tr>
<tr>
<td>PFT</td>
<td>paroxysmal nocturnal dyspnea</td>
</tr>
<tr>
<td>PPD</td>
<td>protein purified derivative (TB test); packs per day (of cigarettes smoked)</td>
</tr>
<tr>
<td>RA</td>
<td>room air (no supplemental oxygen)</td>
</tr>
<tr>
<td>RDS</td>
<td>respiratory distress syndrome</td>
</tr>
<tr>
<td>RLL</td>
<td>right lower lobe (of the lung)</td>
</tr>
<tr>
<td>RML</td>
<td>right middle lobe (of the lung)</td>
</tr>
<tr>
<td>RRT</td>
<td>registered respiratory therapist</td>
</tr>
<tr>
<td>RUL</td>
<td>right upper lobe (of the lung)</td>
</tr>
<tr>
<td>SARS</td>
<td>severe acute respiratory syndrome</td>
</tr>
<tr>
<td>SIDS</td>
<td>sudden infant death syndrome</td>
</tr>
<tr>
<td>SOB**</td>
<td>shortness of breath</td>
</tr>
<tr>
<td>TPR</td>
<td>temperature, pulse, and respiration</td>
</tr>
<tr>
<td>URI</td>
<td>upper respiratory infection</td>
</tr>
<tr>
<td>V/Q</td>
<td>ventilation-perfusion (scan)</td>
</tr>
</tbody>
</table>

*This abbreviation is still used, but it is incorrect, as the name of this organism is now *Pneumocystis jiroveci.*

**This abbreviation is still in use, but many hospitals have removed it from their official list of abbreviations because it also has an undesirable meaning that is unrelated to the respiratory system.

## Word Alert

**ABBREVIATIONS**

Abbreviations are commonly used in all types of medical documents; however, they can mean different things to different people and their meanings can be misinterpreted. Always verify the meaning of an abbreviation.

* A&P means *auscultation and percussion*, but it also means *anatomy and physiology*.

* BS means *breath sounds*, but it also means *bowel sounds*.

* C&S means *culture and sensitivity*, but it can also be confused with the sound-alike abbreviation CNS (central nervous system).

* PND means *paroxysmal nocturnal dyspnea*, but it also means *postnasal drip*.

* PPD means *purified protein derivative* (TB test), but it also means *packs per day* (of cigarettes smoked).

* RA means *room air*, but it also means *rheumatoid arthritis* or *right atrium* (of the heart).
Did you notice that some words have two different combining forms? Combining forms from both Greek and Latin languages remain a part of medical language today.

<table>
<thead>
<tr>
<th>Word</th>
<th>Greek</th>
<th>Latin</th>
<th>Medical Word Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>breathe, breathing</td>
<td>spir/o-</td>
<td>hal/o-</td>
<td>respiration, inspiration, inhalation, exhalation</td>
</tr>
<tr>
<td>chest</td>
<td>thorac/o</td>
<td>steth/o-</td>
<td>thoracic, stethoscope</td>
</tr>
<tr>
<td>lung</td>
<td>pneum/o-</td>
<td>pulmon/o-</td>
<td>pneumococcus, pneumoconiosis, pulmonary</td>
</tr>
<tr>
<td>pus</td>
<td>py/o-</td>
<td>purul/o-</td>
<td>pyothorax, empyema, purulent</td>
</tr>
</tbody>
</table>

**Career Focus**

Meet Susan, a respiratory therapist in a hospital

“I love my job. I’ve been doing it for 36 years. I probably could retire, but I choose not to. We treat neonates to geriatric patients. We treat asthma, COPD, and pulmonary fibrosis patients and give information to the patients’ families. We also manage oxygen therapy, nebulizer therapy, and medication therapy. We do pulmonary function technology and blood gases. I feel that being a respiratory therapist allows me to feel respected and appreciated, not only by the medical staff, but by the patients because you are giving patient care. You are dealing with the patient directly, as well as the physician. You feel good at the end of the day when you leave.”

Respiratory therapists are allied health professionals who perform pulmonary function tests and administer respiratory therapy with various types of equipment that provide oxygen or respiratory assistance to a patient.

Pulmonologists are physicians who practice in the medical specialty of pulmonology. They diagnose and treat patients with respiratory problems. Physicians can take additional training and become board certified in the subspecialty of pediatric pulmonology. Cancerous tumors of the lungs are treated medically by an oncologist or surgically by a thoracic or cardiothoracic surgeon.

To see Susan’s complete video profile, visit Medical Terminology Interactive at www.myhealthprofessionskit.com. Select this book, log in, and go to 4th floor of Pearson General Hospital. Enter the Laboratory, and click on the computer screen.
CHAPTER REVIEW EXERCISES

Test your knowledge of the chapter by completing these review exercises. Use the Answer Key at the end of the book to check your answers.

Anatomy and Physiology

Matching Exercise

Match each word or phrase to its description.

1. apex
2. turbinates
3. cilia
4. trachea
5. bronchus
6. bronchiole
7. alveoli
8. pleura
9. diaphragm
10. thorax
11. phrenic nerve

- Small passageway that ends in several alveoli
- Impulse from this structure causes the diaphragm to contract
- Projections of bone in the nasal cavity that break up inhaled air
- Small hairs in the mucosa that move in waves
- Connecting passageway between the trachea and the bronchioles
- Air sacs that are the functional units of the lung
- Double-layered membrane around the lungs and thoracic cavity
- Muscular wall that moves on inhalation
- Topmost part of a lung
- Bony cage surrounding the lungs
- Connecting passageway between the larynx and the bronchi

Circle Exercise

Circle the correct word from the choices given.

1. A large division of a lung that is visible on its surface is known as the (alveolus, apex, lobe).
2. The (bronchioles, lungs, pleura) have smooth muscle around them that can contract.
3. The bronchus, pulmonary arteries, and pulmonary veins enter and exit the lung at the (alveolus, base, hilum).
4. The functional part of the lung that is made up of the alveoli is known collectively as the (bronchioles, mediastinum, parenchyma).
5. Swallowed food does not go into the trachea or lungs because of the (epiglottis, pharynx, turbinates).
6. (Carbon dioxide, Oxygen, Surfactant) keeps the alveoli from collapsing with each breath.
7. The (diaphragm, phrenic nerve, thorax) carries an impulse from the respiratory centers of the brain to initiate inspiration.

True or False Exercise

Indicate whether each statement is true or false by writing T or F on the line.

1. ______ Inhalation is another word for inspiration.
2. ______ The upper respiratory system includes the nose, throat, and lungs.
3. ______ Oxygen is carried in the blood in the form of oxyhemoglobin in a red blood cell.
4. ______ The pharynx is an air passageway that connects the nasal cavity and the bronchi.
5. ______ The alveoli are divided into lobes.
6. ______ The visceral pleura is a serous membrane on the surface of the lung.
7. ______ A normal depth and rate of respirations is known as eupnea.
8. ______ Oxygenated blood contains low levels of oxygen.
Diseases and Conditions

Matching Exercise

Match each word or phrase to its description.

1. apnea
   ______ Caused by trauma; treated with a chest tube
2. asthma
   ______ Blood clot or fat globule in a pulmonary artery
3. hemothorax
   ______ Creates a pleural friction rub
4. pleurisy
   ______ Premature babies often have this lapse in breathing
5. pneumoconiosis
   ______ Caused by allergies, exercise, cold air, or stress
6. pulmonary embolus
   ______ Sternal and intercostal are two types
7. retraction
   ______ Caused by taking aspirin during a viral illness
8. Reye’s syndrome
   ______ Occupational lung disease

True or False Exercise

Indicate whether each statement is true or false by writing T or F on the line.

1. ______ Bronchospasm occurs during an asthma attack.
2. ______ Patients who have orthopnea use pillows to prop themselves up to sleep.
3. ______ Hemoptysis means blood in the thoracic cavity.
4. ______ Asthma is also known as reactive airway disease.
5. ______ The two components of COPD are chronic bronchitis and emphysema.
6. ______ Lobar pneumonia is caused by aspirating food while eating.
7. ______ Tuberculosis is spread by air-borne droplets from an infected person coughing.
8. ______ Purulent sputum contains pus.
9. ______ Double pneumonia is twice as serious as regular pneumonia.

Fill in the Blank Exercise

Fill in the blank with the correct word from the word list.

<table>
<thead>
<tr>
<th>bronchopneumonia</th>
<th>Legionnaire’s disease</th>
<th>status asthmaticus</th>
<th>tuberculosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>carcinoma</td>
<td>pulmonary edema</td>
<td>tachypnea</td>
<td>wheezing</td>
</tr>
<tr>
<td>cystic fibrosis</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Infection that affects the bronchi, bronchioles, and adjacent lung tissue ____________________________
2. Extremely severe, sustained attack of wheezing and difficulty exhaling ______________________________
3. High-pitched whistling or squeaking breath sound ____________________________________________________
4. Eventually fatal, inherited disease of the mucus glands _____________________________________________
5. Abnormally rapid breathing _______________________________________________________________________
6. First identified in 1976 _________________________________________________________________________
7. Malignant tumor of the lung _____________________________________________________________________
8. Fluid in the lungs from heart failure _______________________________________________________________________
9. The bacterium that causes this disease has a waxy, resistant coating ____________________________________
Matching Exercise

Match each word or phrase to its description.

1. bronchoscopy   _____ Taking a chest x-ray
2. carboxyhemoglobin  _____ Carries carbon monoxide in the blood
3. chest tube  _____ Encourages patients to breathe deeply
4. culture and sensitivity  _____ Using a scope to look at the bronchi
5. intubation  _____ Used to treat a pneumothorax
6. radiography  _____ Procedure to ventilate the lungs and circulate the blood
7. resuscitation  _____ Diagnoses a bacterial infection and which antibiotic drug to use
8. spirometer  _____ Incision into the chest
9. thoracotomy  _____ Uses an endotracheal tube

Circle Exercise

Circle the correct word from the choices given.

1. A pneumonectomy involves surgical removal of the (alveoli, lung, trachea).
2. Oxygen therapy is administered by using a/an (ABG, nasal cannula, tracheotomy).
3. (Carboxyhemoglobin, CXR, Pulmonary function test) measures the amount of carbon monoxide in the blood.
4. Expectorant drugs are used to treat (apnea, productive coughs, pneumothorax).

Dividing Medical Words

Separate these words into their component parts (prefix, combining form, suffix). Note: Some words do not contain all three word parts. The first one has been done for you.

<table>
<thead>
<tr>
<th>Medical Word</th>
<th>Prefix</th>
<th>Combining Form</th>
<th>Suffix</th>
<th>Medical Word</th>
<th>Prefix</th>
<th>Combining Form</th>
<th>Suffix</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. inhalation</td>
<td>in</td>
<td>hal/o-</td>
<td>-ation</td>
<td>5. circumoral</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. pharyngeal</td>
<td></td>
<td></td>
<td></td>
<td>6. bronchiectasis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. respiratory</td>
<td></td>
<td></td>
<td></td>
<td>7. panlobar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. hemoptysis</td>
<td></td>
<td></td>
<td></td>
<td>8. pneumothorax</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Building Medical Words

Review the Combining Forms Exercise, Combining Form and Suffix Exercise, Prefix Exercise, and Multiple Combining Forms and Suffix Exercise that you already completed in the anatomy section on pages 162–164.

Combining Forms Exercise

Before you build respiratory words, review these additional combining forms. Next to each combining form, write its medical meaning. The first one has been done for you.

<table>
<thead>
<tr>
<th>Combining Form</th>
<th>Medical Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. aden/o-</td>
<td>gland</td>
</tr>
<tr>
<td>2. anthrac/o-</td>
<td></td>
</tr>
<tr>
<td>3. aspir/o-</td>
<td></td>
</tr>
<tr>
<td>4. asthm/o-</td>
<td></td>
</tr>
<tr>
<td>5. atel/o-</td>
<td></td>
</tr>
<tr>
<td>6. auscult/o-</td>
<td></td>
</tr>
<tr>
<td>7. carbox/y-</td>
<td></td>
</tr>
<tr>
<td>8. carcin/o-</td>
<td></td>
</tr>
<tr>
<td>9. cocc/o-</td>
<td></td>
</tr>
<tr>
<td>10. coni/o-</td>
<td></td>
</tr>
<tr>
<td>11. cyan/o-</td>
<td></td>
</tr>
<tr>
<td>12. dilat/o-</td>
<td></td>
</tr>
<tr>
<td>13. embol/o-</td>
<td></td>
</tr>
<tr>
<td>14. log/o-</td>
<td></td>
</tr>
<tr>
<td>15. obstruct/o-</td>
<td></td>
</tr>
<tr>
<td>16. percuss/o-</td>
<td></td>
</tr>
<tr>
<td>17. purul/o-</td>
<td></td>
</tr>
<tr>
<td>18. py/o-</td>
<td></td>
</tr>
<tr>
<td>19. resect/o-</td>
<td></td>
</tr>
<tr>
<td>20. resuscit/o-</td>
<td></td>
</tr>
<tr>
<td>21. therap/o-</td>
<td></td>
</tr>
<tr>
<td>22. tubercul/o-</td>
<td></td>
</tr>
<tr>
<td>23. tuber/o-</td>
<td></td>
</tr>
<tr>
<td>24. tuss/o-</td>
<td></td>
</tr>
</tbody>
</table>

Multiple Combining Forms and Suffix Exercise

Read the definition of the medical word. Select the correct suffix and combining forms. Then build the medical word and write it on the line. Be sure to check your spelling. The first one has been done for you.

<table>
<thead>
<tr>
<th>SUFFIX LIST</th>
<th>COMBINING FORM LIST</th>
</tr>
</thead>
<tbody>
<tr>
<td>-al (pertaining to)</td>
<td>aden/o- (gland) glob/o- (shaped like a globe; comprehensive)</td>
</tr>
<tr>
<td>-ia (condition; state; thing)</td>
<td>bronch/o- (bronchus) hem/o- (blood)</td>
</tr>
<tr>
<td>-ic (pertaining to)</td>
<td>carbox/y- (carbon monoxide) log/o- (word; the study of)</td>
</tr>
<tr>
<td>-in (a substance)</td>
<td>carcin/o- (cancer) pneum/o- (lung; air)</td>
</tr>
<tr>
<td>-ist (one who specializes in)</td>
<td>cardi/o- (heart) pneumon/o- (lung; air)</td>
</tr>
<tr>
<td>-oma (tumor; mass)</td>
<td>cocc/o- (spherical bacterium) pulmon/o- (lung)</td>
</tr>
<tr>
<td>-or (person or thing that produces or does)</td>
<td>dilat/o- (dilate; widen) thorac/o- (thorax; chest)</td>
</tr>
</tbody>
</table>

Definition of the Medical Word

1. Pertaining to the heart and thorax
2. Tumor of a gland that is a cancer
3. Thing (a drug) that produces or does (something to make the) bronchus widen
4. Condition of (inflammation or infection) of the bronchi and lung
5. Pertaining to (an infection in the) lung (that is caused by a) spherical bacterium
6. A substance (that carries) carbon monoxide (in the) blood (and is) shaped like a globe
7. One who specializes in the lung (and) the study of (it)
Combining Form and Suffix Exercise

Read the definition of the medical word. Select the correct suffix from the Suffix List. Select the correct combining form from the Combining Form List. Build the medical word and write it on the line. Be sure to check your spelling. The first one has been done for you.

### SUFFIX LIST

- atic (pertaining to)
- ation (a process; being or having)
- ator (person or thing that produces or does)
- centesis (procedure to puncture)
- ectasis (condition of dilation)
-ectomy (surgical excision)
- ia (condition; state; thing)
- ist (one who specializes in)
- isy (condition of inflammation or infection)
- itis (inflammation of; infection of)
- meter (instrument used to measure)
- metry (process of measuring)
- osis (condition; abnormal condition; process)
- pnea (breathing)
- ptyisis (abnormal condition of coughing up)
- scope (instrument used to examine)
- scopy (process of using an instrument to examine)
- spasm (sudden, involuntary muscle contraction)
- stomy (surgically created opening)
- thorax (thorax; chest)
- tomy (process of cutting or making an incision)

### COMBINING FORM LIST

- anthrac/o- (coal)
- asthm/o- (asthma)
- auscult/o- (listening)
- bronchi/o- (bronchus)
- bronch/o- (bronchus)
- cyan/o- (blue)
- hem/o- (blood)
- laryng/o- (larynx; voice box)
- lob/o- (lobe of an organ)
- orth/o- (straight)
- ox/i- (oxygen)
- pleur/o- (pleura; lung membrane)
- pneum/o- (lung; air)
- pneumon/o- (lung; air)
- py/o- (pus)
- resuscit/o- (revive; raise up again)
- spir/o- (breathe; a coil)
- steth/o- (chest)
- therap/o- (treatment)
- thorac/o- (thorax; chest)
- trache/o- (trachea; windpipe)
- ventil/o- (movement of air)

### Definition of the Medical Word

1. Pertaining to asthma
2. Inflammation of or infection of the bronchus
3. Thorax (that contains) pus
4. A process of listening (to the lung sounds)
5. Abnormal condition (of the skin being) blue
6. Surgically created opening into the trachea
7. Abnormal condition of coughing up blood
8. Surgical excision of a lung
9. Instrument used to examine (listen to) the chest
10. Sudden, involuntary muscle contraction (around the) bronchus
11. Condition of dilation of the bronchus
12. Instrument used to measure the oxygen (content of the blood)
13. Person or thing that produces movement of air
14. Instrument used to examine the larynx
15. Condition of inflammation or infection of the pleura
16. Condition (of infection) in the lung
17. Abnormal condition (of having) coal dust in the lungs
18. Process of cutting or making an incision (into the) thorax

### Build the Medical Word

1. **asthmatic**
2. 
3. 
4. 
5. 
6. 
7. 
8. 
9. 
10. 
11. 
12. 
13. 
14. 
15. 
16. 
17. 
18. 

---

Definition of the Medical Word

19. Process of using an instrument to examine the bronchus
20. Surgical excision of a lobe (of the lung)
21. One who specializes in treatment
22. (Abnormal condition of) the thorax (having) air (in it)
23. Thorax (that contains) blood
24. Instrument used to measure (the volume that the patient) breathes
25. A process to revive or raise up again (a patient)
26. Process of measuring oxygen (in the blood)
27. Procedure to puncture the thorax (with a needle)
28. Breathing (in a) straight (up position)

Build the Medical Word

Related Combining Forms Exercise
Write the combining forms on the line provided. (Hint: See the It’s Greek to Me feature box.)

1. Three combining forms that mean breathe, breathing. ________________________________________________________
2. Three combining forms that mean chest. ________________________________________________________
3. Three combining forms that mean lung. ________________________________________________________

Prefix Exercise
Read the definition of the medical word. Look at the medical word or partial word that is given (it already contains a combining form and suffix). Select the correct prefix from the Prefix List and write it on the blank line. Then build the medical word and write it on the line. Be sure to check your spelling. The first one has been done for you.

Prefix List

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Word or Partial Word</th>
<th>Build the Medical Word</th>
</tr>
</thead>
<tbody>
<tr>
<td>an-</td>
<td>(without; not)</td>
<td></td>
</tr>
<tr>
<td>anti-</td>
<td>(against)</td>
<td></td>
</tr>
<tr>
<td>dys-</td>
<td>(painful; difficult; abnormal)</td>
<td></td>
</tr>
<tr>
<td>em-</td>
<td>(in)</td>
<td></td>
</tr>
<tr>
<td>endo-</td>
<td>(innermost; within)</td>
<td></td>
</tr>
<tr>
<td>ex-</td>
<td>(out; away from)</td>
<td></td>
</tr>
<tr>
<td>hyper-</td>
<td>(above; more than normal)</td>
<td></td>
</tr>
<tr>
<td>in-</td>
<td>(in; within; not)</td>
<td></td>
</tr>
<tr>
<td>pan-</td>
<td>(all)</td>
<td></td>
</tr>
<tr>
<td>tachy-</td>
<td>(fast)</td>
<td></td>
</tr>
</tbody>
</table>

Definition of the Medical Word

1. A process of within (the trachea putting) a tube
2. Pertaining to difficult breathing
3. Pertaining to (being in) all lobes (of the lung)
4. Condition of more than normal carbon dioxide
5. Pertaining to (a drug that is) against cough(ing)
6. Pertaining to fast breathing
7. Condition (of being) without oxygen
8. Condition in (the lung of) pus
9. Pertaining to within the trachea
10. Pertaining to (a drug that takes sputum) out (of the chest)
Abbreviations

Matching Exercise

Match each abbreviation to its description.

1. SOB   ______  Inhaler device used to give a bronchodilator drug
2. FVC   ______  Forced vital capacity
3. PFT   ______  Disease that includes bronchitis and emphysema
4. TB    ______  Synonym for dyspnea
5. COPD  ______  Tuberculosis
6. CXR   ______  Radiology test of the chest
7. MDI   ______  Includes FVC and FEV₁
8. CPR   ______  Resuscitation

Applied Skills

Plural Noun and Adjective Spelling Exercise

Read the noun and write its plural form and/or adjective form. Be sure to check your spelling. The first one has been done for you.

<table>
<thead>
<tr>
<th>Singular Noun</th>
<th>Plural Noun</th>
<th>Adjective</th>
<th>Singular Noun</th>
<th>Plural Noun</th>
<th>Adjective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. nose</td>
<td>nasal</td>
<td></td>
<td>10. hilum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. alveolus</td>
<td></td>
<td>nasal</td>
<td>11. larynx</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. anoxia</td>
<td></td>
<td></td>
<td>12. lung</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. apex</td>
<td></td>
<td></td>
<td>13. mucosa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. apnea</td>
<td></td>
<td></td>
<td>14. pharynx</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. asthma</td>
<td></td>
<td></td>
<td>15. pleura</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. bronchus</td>
<td></td>
<td></td>
<td>16. tachypnea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. cyanosis</td>
<td></td>
<td></td>
<td>17. thorax</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. diaphragm</td>
<td></td>
<td></td>
<td>18. trachea</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

English and Medical Word Equivalents Exercise

For each English word, write its equivalent medical word. Be sure to check your spelling. The first one has been done for you.

<table>
<thead>
<tr>
<th>English Word</th>
<th>Medical Word</th>
<th>English Word</th>
<th>Medical Word</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. throat</td>
<td>pharynx</td>
<td>6. flu</td>
<td></td>
</tr>
<tr>
<td>2. black lung disease</td>
<td></td>
<td>7. shortness of breath</td>
<td></td>
</tr>
<tr>
<td>3. chest</td>
<td></td>
<td>8. common cold</td>
<td></td>
</tr>
<tr>
<td>4. collapsed lung</td>
<td></td>
<td>9. voice box</td>
<td></td>
</tr>
<tr>
<td>5. crib death</td>
<td></td>
<td>10. windpipe</td>
<td></td>
</tr>
</tbody>
</table>
Medical Report Exercise

This exercise contains a report of an admission to an acute care hospital. Read the report and answer the questions.

**ADMISSION HISTORY AND PHYSICAL EXAMINATION**

PATIENT NAME: OTT, George
HOSPITAL NUMBER: 208-333-7943
DATE OF ADMISSION: November 19, 20xx

**HISTORY OF PRESENT ILLNESS**
This 65-year-old Caucasian male was evaluated by me in the emergency department on the above date, complaining of progressive shortness of breath, coughing, fever, and fatigue.

**PAST HISTORY**
The patient was a coal miner for 25 years before he retired on disability with black lung disease at age 55. He currently smokes 2 packs of cigarettes per day and has done so for the past 22 years. Past surgical history of an appendectomy in the remote past. Chest x-ray done recently showed a suspicious lesion in the LLL; a bronchoscopy was performed and a biopsy was done, but the biopsy results were negative for malignancy.

**PHYSICAL EXAMINATION**

VITAL SIGNS: Pulse 110, respiratory rate 42 per minute, temperature 100.6, blood pressure 156/96.
GENERAL: The patient appears older than his stated age and quite tired at this time.
HEENT: Negative, except for slight cyanosis of the lips. The neck is supple and free of any masses.
CHEST: There is an increased anteroposterior diameter to the chest. There are no intercostal retractions during inspiration. There are diffuse expiratory wheezes, but no rales or rhonchi.
HEART: Normal heart sounds without murmur, gallop, or rub.
ABDOMEN: Soft and nontender.
EXTREMITIES: Normal with full range of motion noted. There was no clubbing of the fingers noted.

**LABORATORY DATA**
Complete blood count showed an elevated white blood cell count of 17,600 with 80 segs, 4 bands, and 2 lymphs. Oximeter showed 70% saturation. Sputum was sent for C&S. Chest x-ray: Patchy infiltrates from the apex to the midlung on the right with some consolidative changes involving the entire right lower lobe. There is no pleural fluid noted. There is a density seen in the left lower lobe posterolaterally, which extends to the pleural surface. It is most probably focal scarring or atelectasis from old inflammation.

**IMPRESSION**
1. Right-sided pneumonia.
2. Chronic obstructive pulmonary disease, secondary to anthracosis and smoking.

Christina S. Jencks, M.D.

Christina S. Jencks, M.D.
CSJ: lcc
D: 11/19/xx
T: 11/19/xx
Word Analysis Questions

1. This patient has dyspnea. What phrase in the History of Present Illness says the same thing? ______________________ What is the medical abbreviation for this phrase? ______________________

2. If you wanted to use the adjective form of dyspnea, you would say, “The patient is ______________________.”

3. Divide bronchoscopy into its two word parts and define each word part.

<table>
<thead>
<tr>
<th>Word Part</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Divide cyanosis into its two word parts and define each word part.

<table>
<thead>
<tr>
<th>Word Part</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. What do these abbreviations stand for?
   a. C&S __________________________________________________________________________________________________________
   b. COPD __________________________________________________________________________________________________________
   c. LLL __________________________________________________________________________________________________________

Fact Finding Questions

1. What is the medical word for black lung disease? __________________________________________________________________________________________________________

2. What respiratory surgery did the patient have in the past? __________________________________________________________________________________________________________

3. What other surgery did the patient have? __________________________________________________________________________________________________________

4. Circle all of the abnormalities that were seen on the patient’s CXR.
   - intercostal muscles
   - consolidative changes
   - density in LLL
   - cyanosis
   - oximeter
   - patchy infiltrates
   - pleural fluid

Critical Thinking Questions

1. Of the four medical complaints the patient had when he came to the emergency department, which one was directly related to an infection? __________________________________________________________________________________________________________

2. What is the descriptive name that laypersons give for the medical condition of increased anteroposterior diameter of the chest that is seen in patients with chronic obstructive pulmonary disease? __________________________________________________________________________________________________________

3. What method of examination would the physician use to hear the patient’s expiratory wheezes? (Circle one)
   - auscultation
   - percussion
   - postural drainage
   - oximeter

4. The patient has an elevated white blood cell count of 17,600, which indicates an infection. This is due to which of the two diagnoses listed in the Impression section? __________________________________________________________________________________________________________

5. Calculate the number of pack-years for this patient’s history of smoking. __________________________________________________________________________________________________________
Chapter 4 | Pulmonology

Hearing Medical Words Exercise
You hear someone speaking the medical words given below. Read each pronunciation and then write the medical word it represents. Be sure to check your spelling. The first one has been done for you.

1. an-AWK-see-ah  anoxia
2. az-MAT-ik _______________________
3. AWS-kul-TAY-shun _______________________
4. brong-KAWS-koh-pee _______________________
5. EM-fih-SEE-mah _______________________
6. hee-MAWP-tih-sis _______________________
7. lah-RIN-jee-al _______________________
8. loh-BEK-toh-mee _______________________
9. NOO-moh-THOR-aks _______________________
10. TRAY-kee-AWS-toh-mee _______________________

Pronunciation Exercise
Read the medical word. Then review the syllables in the pronunciation. Circle the primary (main) accented syllable. The first one has been done for you.

1. bronchitis (brong-KY-tis)
2. bronchopulmonary (brong-koh-pul-moh-nair-ee)
3. cyanosis (sy-ah-noh-sis)
4. pneumonia (noo-moh-nee-ah)
5. respiration (res-pih-ray-shun)
6. thoracic (thoh-ras-ik)
7. tracheal (tray-kee-al)
8. tracheostomy (tray-kee-aws-toh-mee)

On the Job Challenge Exercise
On the job, you will encounter new medical words. Practice your medical dictionary skills by looking up the phrases **cystic fibrosis** and **respiratory distress syndrome**. Did you find the complete definition under the first, second, or third word of the phrase? Which way of word searching is more effective? Write a word searching rule to help you remember how to look up these phrases.

1. cystic fibrosis
   Complete definition is under: cystic fibrosis (Circle one)
2. respiratory distress syndrome
   Complete definition is under: respiratory distress syndrome (Circle one)
3. Wordsearching rule: __________________________________________________________________________________________________

Multimedia Preview

Immerse yourself in a variety of activities inside Medical Terminology Interactive. Getting there is simple:

2. Select “Medical Terminology” from the choice of disciplines.
3. First-time users must create an account using the scratch-off code on the inside front cover of this book.
4. Find this book and log in using your username and password.
5. Click on Medical Terminology Interactive.
6. Take the elevator to the 4th Floor to begin your virtual exploration of this chapter!

**Popping Words**  Popping pills won’t help you study, but popping words might do the trick. Test your knowledge by launching the term pill into the correct container. Ready, aim, fire!

**Strikeout**  Click on the alphabet tiles to fill in the empty squares in the word or phrase to complete the sentence. This game quizzes your vocabulary and spelling. But choose your letters carefully because three strikes and you’re out!