

# Respiratory System



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# Respiratory System

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## Objective Sheet

### SPECIFIC OBJECTIVES

After completing this module, you should be able to:

1. Define the term **respiratory system**.
2. Complete statements that describe the characteristics of pulmonary ventilation.
3. Select true statements concerning terms used to measure the various aspects of respiratory volume.
4. Distinguish among the portions of the thorax that are related to the lungs.
5. Match the major organs and structures of the respiratory system to their descriptions.
6. Label the major organs and structures of the respiratory system.
7. Complete statements that describe the characteristics and structures of the nose that are related to the respiratory system.
8. Select true statements that describe the characteristics of the pharynx that are related to the respiratory system.
9. Complete statements that describe the characteristics and structures of the larynx that are related to the respiratory system.
10. Select true statements that describe the characteristics and structures of the trachea.
11. Complete statements that describe the characteristics and structures of the bronchi.
12. Label the major structures of the bronchi.
13. Complete statements that describe the characteristics and structures of the lungs.
14. Label the major external structures of the lungs.
15. Complete statements that describe the characteristics and structures of the pleura.
16. Label the major structures of the pleura.
17. Complete statements that describe the muscles that change the size of the thorax.
18. Match common disorders and abnormalities of the respiratory system to their definitions.
19. Practice critical thinking: investigate lung-transplant procedures. (Assignment Sheet 1)

## Information Sheet

## OBJECTIVE 1

## The term respiratory system

## KEY TERMS

**Cellular respiration**—The process of oxygen carried by the blood passing into the cells and being used by the cells, which leads to the production of carbon dioxide that is then carried away by the blood

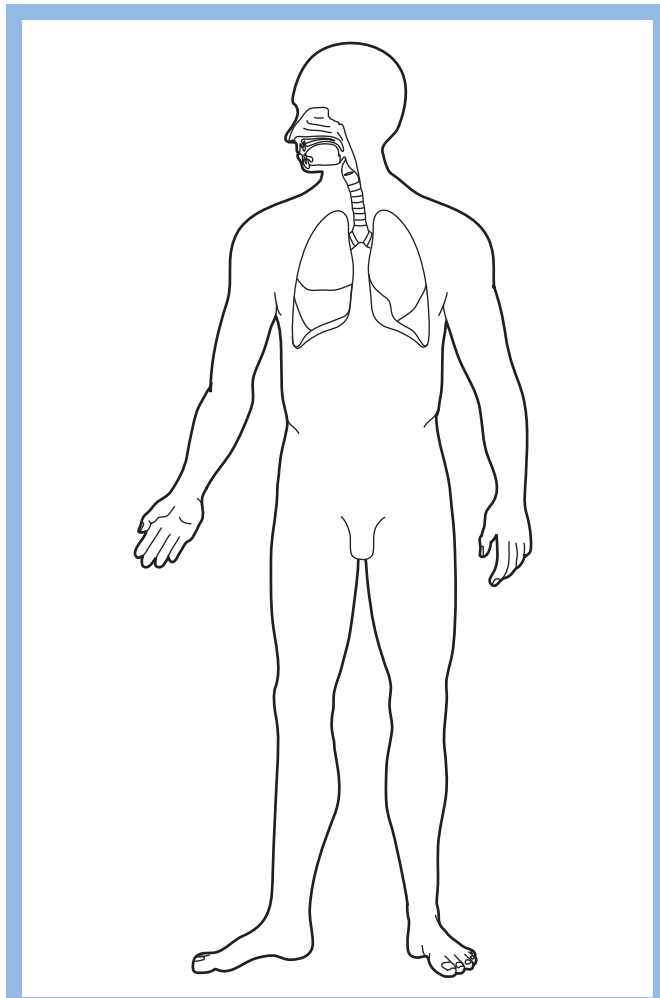
- ✓ **Note:** Cellular respiration is also called **internal respiration**.

**Pulmonary ventilation**—The process of inhaling and exhaling air through the lungs; breathing

- ✓ **Note:** Pulmonary ventilation is also called **external respiration**.

**Respiratory system**—The complex of organs and structures that performs the **pulmonary ventilation** of the body and **cellular respiration**

- ✓ **Note:** As you have studied previously, the cells undergo respiration. During the process of converting nutrients to energy, oxygen is required to fuel the chemical reaction and carbon dioxide is produced as a by-product of the reactions. You also know that the bloodstream carries the required oxygen to the cells and removes the carbon dioxide and other wastes. The source of oxygen is the air around us, which is approximately 21 percent oxygen at sea level. However, getting the oxygen out of the air and into the bloodstream is a specialized process performed by the respiratory system.



**Figure 1**  
Respiratory system

## KEY TERMS

**Brainstem**—The part of the brain composed of the **mesencephalon**, pons, and medulla oblongata and connecting the spinal cord with the forebrain and cerebrum

**Carotid body**—A small structure containing neural tissue at the bifurcation of the carotid arteries

**Chemoreceptor** (ke´-mo-ri-sep-tuhr)—A sensory nerve cell activated by chemical stimuli, such as a chemoreceptor in the carotid artery that is sensitive to a chemical in the blood that signals the respiratory center in the brain to increase or decrease respiration

**Medulla oblongata** (muh-duh´-luh aw-blon-gaw´-tuh)—One of the three parts of the brainstem that contains the cardiac, vasomotor, and the respiratory centers of the brain

**Mesencephalon** (me-zen-se´-puh-lawn)—One of the three parts of the brainstem, lying just below the cerebrum and just above the pons

**Phrenic** (fren´-ik) **nerve**—The motor nerve to the diaphragm

**Pons** (pawnz´)—A broad mass of nerve fibers conspicuous on the ventral surface of the brainstem

- ✓ **Note:** Pulmonary ventilation (breathing) is a mechanical process. The lungs are alternately expanded by movement of the diaphragm, which creates low pressure in the lungs and allows air to be drawn in. To breathe out, the diaphragm relaxes, allowing the lungs to compress, thus forcing air out of the lungs.
  - a. The mechanical portion of pulmonary ventilation (external respiration) is referred to as breathing.
  - b. There are two stages to breathing: inhalation and exhalation (inspiration and expiration).
  - c. Breathing is controlled by the **medulla oblongata** and the **pons** of the **brainstem**.
    - ✓ **Note:** Breathing can be consciously controlled by the central cortex. As we hold our breath or speak or shout, the volume of air exhaled is consciously regulated. However, if we try to hold our breath too long or speak too rapidly or too long, the medulla will force the respiratory system to breathe.
  - d. The brain sends impulses down the spinal cord to the **phrenic nerve** and out to the diaphragm.
  - e. If the brainstem is severed in the cervical area or if the phrenic nerve is severed, respiration will cease.
  - f. The medulla is governed by variations in the chemistry of the blood that are detected by **chemoreceptors** in the **carotid body** and the aortic arch.
  - g. The major regulator of respiration is the carbon-dioxide level in the blood; high concentrations of carbon dioxide increase the rate of respiration, while decreased concentrations of carbon dioxide slow the rate of respiration.

h. Normal pulmonary ventilation (external respiration) occurs at a rate of 14 to 20 times per minute.

✓ **Note:** Breathing rates vary with a number of factors, both internal and external. The rate of breathing usually increases with exercise, during times of excitement, when the oxygen level is low (as in higher altitudes), and with different diseases.

### OBJECTIVE 3

#### Terms used to measure the various aspects of respiratory volume

✓ **Note:** Breathing is a good indicator of many health factors. The rate of breathing, breath sounds, and several measurements of respiratory volume—the amount of air in the lungs—may indicate problems with the respiratory system.

a. Tidal volume—The amount of air involved in one respiration cycle, totaling approximately 1 pint (500 milliliters)

b. Minute respiratory volume—The amount of air inhaled and exhaled during a one-minute period, averaging approximately 6 quarts (6000 milliliters or 6 liters)

c. Inspiratory volume—The amount of air that can be taken in with the deepest possible inhalation beyond tidal volume, amounting to 2 to 3 quarts (2000 to 3000 milliliters)

d. Expiratory volume—The amount of air that can be expelled with the most-forceful exhalation possible beyond tidal volume, amounting to 1 to 1½ quarts (1000 to 1500 milliliters)

e. Vital capacity—The total respiration volume calculated as the sum of tidal volume, inspiratory volume, and expiratory volume, totaling 3½ to 5 quarts (3500 to 5000 milliliters)

f. Residual air—The amount of air that remains in the lungs after the most-forceful expiration, amounting to 1 to 1½ quarts (1000 to 1500 milliliters)

✓ **Note:** The lungs are never entirely emptied of air. Normally, the volume of air left in the lungs after an exhalation is a volume that provides equalized air pressure with the outside air. However, by using the intercostal muscles, additional air can be forced from the lungs. Even then, some air will remain.

### OBJECTIVE 4

#### Portions of the thorax that are related to the lungs

a. The thorax (thor-aks'), which is also called the chest, is the part of the body between the neck and the abdomen; it is the cavity where the heart and lungs lie.

b. The pleural cavity is the cavity within the thorax that contains the lungs.

c. The mediastinum (me-de-uh-sti'-nuhm) is the space in the thorax between the two lungs (see Figure 2).

**OBJECTIVE 5****Major organs and structures of the respiratory system** (see Figure 2)

## KEY TERM

**Saccular** (sa'-kyuh-luhr)—Resembling a sac

- ✓ **Note:** The principal organs of the respiratory system are the lungs. However, a number of auxiliary structures are required to support respiration, including pathways to carry air to and from the lungs and muscles to pump the lungs.
- a. Nose—The structure that protrudes from the anterior portion of the skull and serves as part of the passageway for air to and from the lungs
  - ✓ **Note:** You will learn more about the nose as it relates to the respiratory system in Objective 7.
- b. Pharynx (far'-in{k}s)—The throat; the muscular, tubular structure that extends from the base of the skull to the esophagus and serves as a passageway for both the respiratory and digestive tracts
  - ✓ **Note:** You will learn more about the pharynx as it relates to the respiratory system in Objective 8.
- c. Larynx (lar'-in{k}s)—The organ of voice that is part of the air passageway connecting the pharynx with the trachea
  - ✓ **Note:** You will study more about the larynx as it relates to the respiratory system in Objective 9.
- d. Trachea (tra'-ke-uh)—The windpipe; the nearly cylindrical tube in the neck that extends from the lower end of the larynx to the point where it divides into the two bronchi of the lungs
  - ✓ **Note:** You will learn more about the trachea in Objective 10.
- e. Bronchi (brawn'-ke)—The large air passages in the lungs through which pass inspired air and exhaled waste gases
  - ✓ **Note:** Each bronchus (brawn'-kus) has a wall consisting of three layers. The outermost layer is made of dense fibrous tissue reinforced with cartilage; the middle layer is a network of smooth muscle; the innermost layer consists of ciliated mucous membrane

You will learn more about the bronchi in Objective 11 and Objective 12.
- f. Lungs—The two light, spongy, highly elastic, **saccular** organs located in the thoracic cavity and constituting the main components of the respiratory system for inspiring air and exhaling carbon dioxide
  - ✓ **Note:** You will study more about the lungs in Objective 13 and Objective 14.
- g. Pleura (plur'-uh)—The delicate serous membrane that lines each half of the thorax and is folded over the surface of the lung on the same side
  - ✓ **Note:** You will study more about the pleurae (plur'-e) in Objective 15 and Objective 16.
- h. Diaphragm (di'-uh-fram)—The dome-shaped partition of muscle and connective tissue that



separates the thoracic and the abdominal cavities and aids respiration by moving up and down

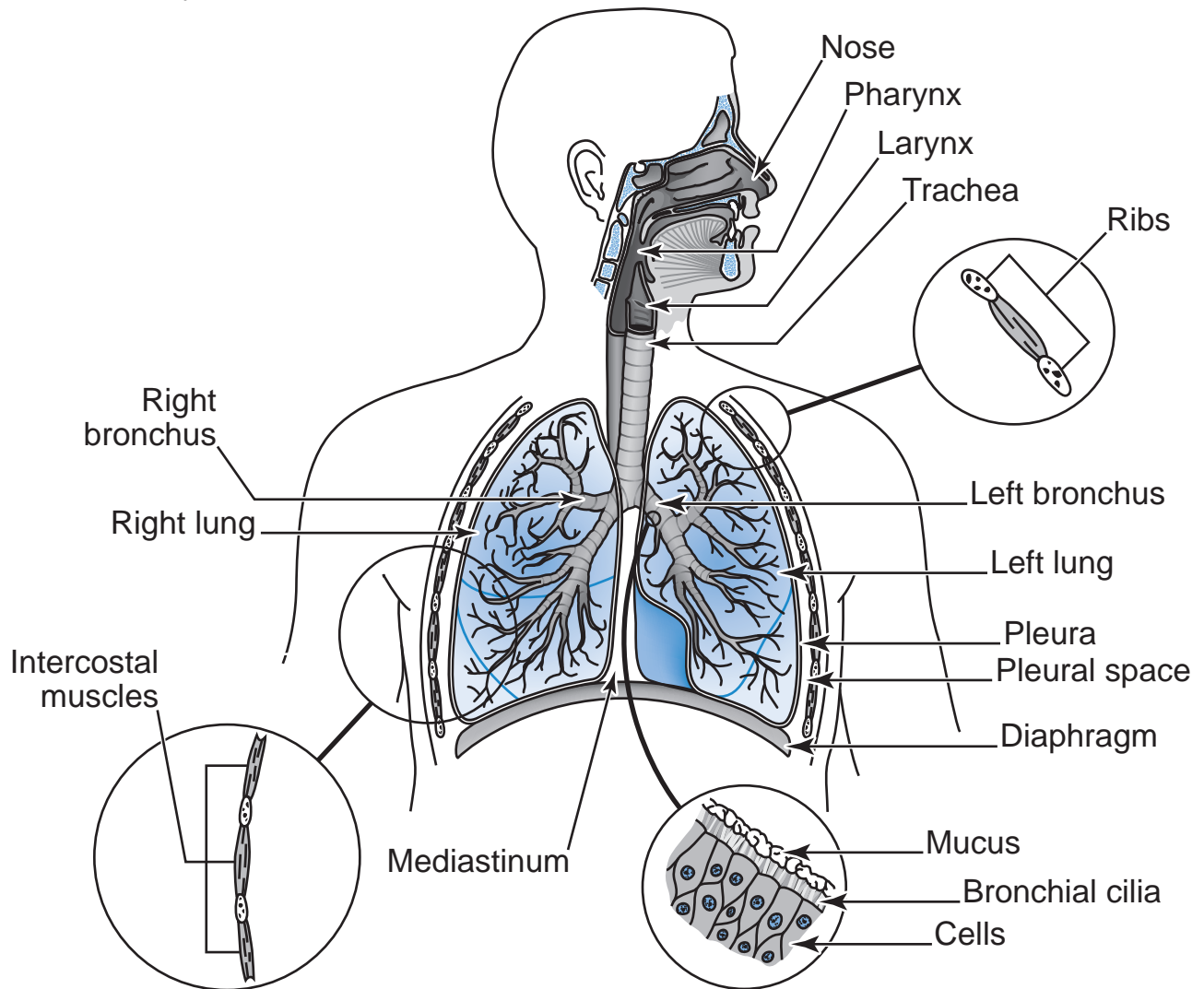
✓ **Note:** You will learn more about the diaphragm in Objective 17.

i. Intercostal (in´tuhr-kaws-tuhl) muscles—The muscles between the ribs

✓ **Note:** You will study more about the intercostal muscles in Objective 17.

## OBJECTIVE 6

### Major organs and structures of the respiratory system



**Figure 2**  
Major organs and structures of the respiratory system

**OBJECTIVE 7****Characteristics and structures of the nose that are related to the respiratory system**

KEY TERM

**Concha** (kawn´-kuh)—Something shaped like a shell

- a. The nose serves as a passageway for air going to the lungs.
- b. The nose warms, moistens, and filters air passing into it.
- c. The openings in the front of the nose are known as **nostrils** or **anterior nares** (nar´-ez).
- d. The nose consists of two nasal cavities; the nasal cavities lie between the roof of the mouth and the cranium.
- e. The nasal cavities are separated by a vertical partition known as the **nasal septum**.
- f. The nasal cavities are constructed of bone covered by ciliated mucous membranes.
- g. On the side walls of the nasal cavities are three projections known as **nasal conchae** or **turbinates** that greatly increase the surface area over which air must travel before reaching the lungs.
- h. The mucous membranes of the nose are very vascular because they contain many blood vessels that bring warmth and moisture to these surfaces.
- i. The nasal sinuses—the cavities in the various bones of the skull that are continuous with the nasal cavity—may also function to warm, moisten, and filter air before it enters the rest of the respiratory system, but the purpose of these cavities is not clear.

**OBJECTIVE 8****Characteristics of the pharynx that are related to the respiratory system**

KEY TERM

**Hyoid** (hi´-oid) **bone**—The U-shaped bone situated at the base of the tongue and supporting the tongue and its muscles

- a.. The pharynx is about 5 inches (12.5 centimeters) long and is composed of muscle lined with mucous membrane.
- b. The pharynx passes air from the nasal cavities to the larynx.
- c. The pharynx consists of three divisions: the nasopharynx, the oropharynx, and the laryngopharynx.
- d. The nasopharynx is the upper portion of the pharynx that lies behind the nose and above the palate.

- e. The oropharynx is the middle portion of the pharynx that lies behind the mouth and between the palate and the **hyoid bone**.
- f. The laryngopharynx is the lower portion of the pharynx that lies immediately below the hyoid bone and above the larynx.

**OBJECTIVE 9**

**Characteristics and structures of the larynx that are related to the respiratory system**

- a. The larynx is shaped like a triangular box with flat sides and a prominent ridge in front.
- b. The larynx consists of nine pieces of cartilage that are connected by ligaments and are moved by various muscles.
- c. The three prominent cartilages of the larynx are the thyroid cartilage, the epiglottis (e-puh-glaw´-tuhs), and the cricoid (kri´-koid) cartilage.
- d. The thyroid cartilage is the largest and is commonly called the **Adam’s apple**; this cartilage is usually larger in men than in women.
- e. The epiglottis covers the entrance into the larynx during swallowing, thus preventing food or liquids from entering the airway.
- f. The cricoid cartilage is the lowest of the cartilage structures and has the appearance of a signet ring.

**OBJECTIVE 10**

**Characteristics and structures of the trachea**

KEY TERM

**Hyaline** (hi´-uh-luhn) **cartilage**—The translucent, bluish-white cartilage present in the joints and in the respiratory passages

- a. The trachea is about 4½ inches (11 centimeters) long and about 1 inch (2.5 centimeters) from side to side.
- b. The trachea is a tube of smooth muscle lined with mucous membrane.
- c. The muscle tissue is strengthened and held open by 16 to 20 C-shaped rings of **hyaline cartilage**, each with the open portion of the C toward the posterior near the esophagus.

**OBJECTIVE 11**

**Characteristics and structures of the bronchi**

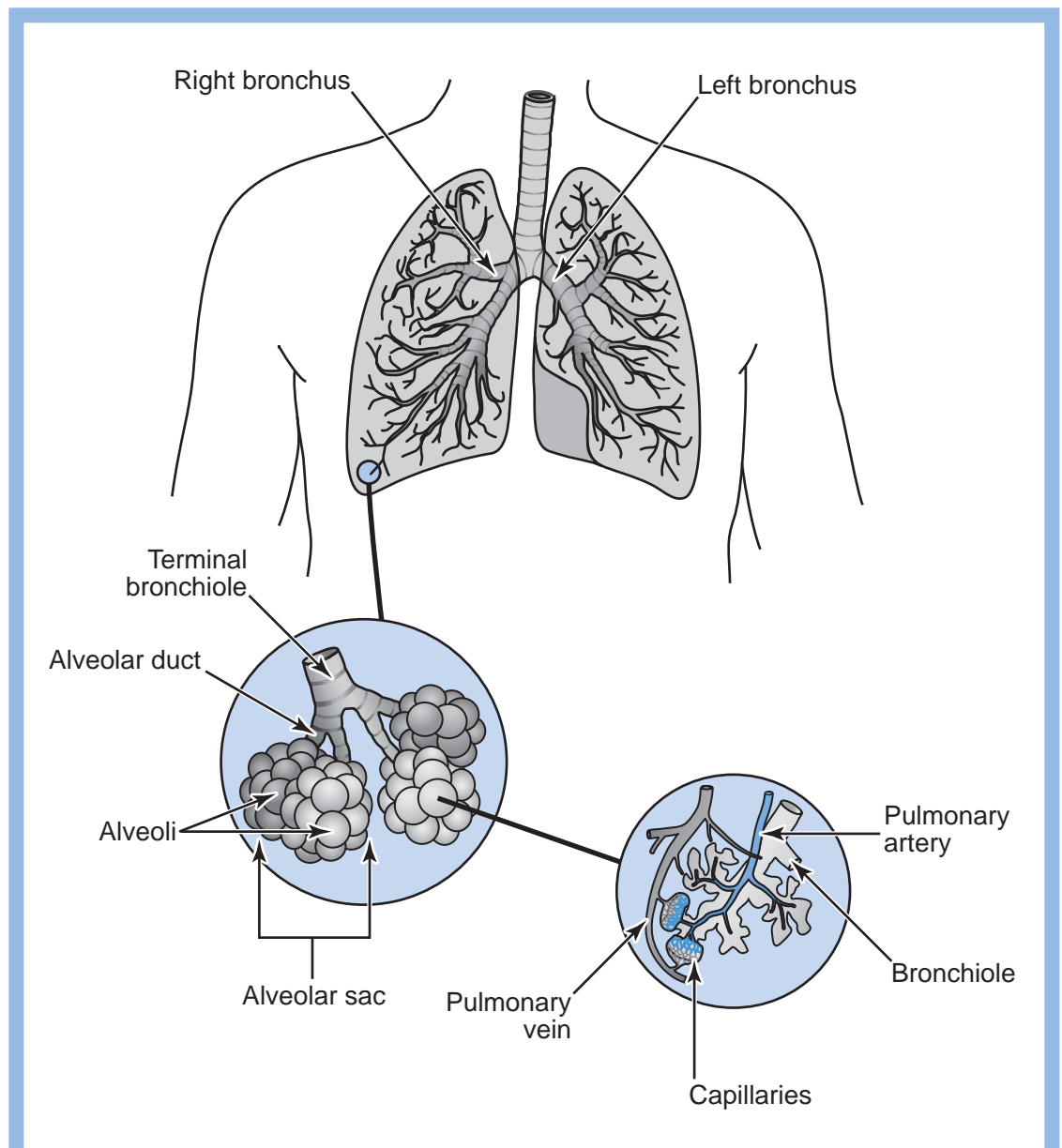
- a. The bronchi consist of two primary bronchi: the right bronchus and the left bronchus (see Figure 2 and Figure 3).
- b. The right bronchus is shorter and more vertical than the left bronchus.
- c. The structure of the bronchi resembles the trachea as the walls contain cartilage rings and ciliated mucous lining.

- d. Each bronchus enters the lung at the notch or depression on the medial surface called the **hilus** (hi'-lus) or **hilum** (hi'-luhm).
  - e. Each primary bronchus enters the lung on its respective side and immediately subdivides into smaller branches called **secondary bronchi**.
  - f. Secondary bronchi continue to branch, forming small bronchioles, which lack cartilage (see Figure 3).
  - g. The bronchioles subdivide into smaller and smaller tubes, eventually ending in microscopic branches that divide into alveolar ducts, ending in several alveolar sacs that consist of numerous alveoli (see Figure 3).
  - h. Alveolar ducts and sacs look like a cluster of grapes with the stem as the alveolar duct, each cluster as an alveolar sac, and each grape as an alveolus (see Figure 3).
  - i. The alveoli are enveloped by networks of capillaries that provide spaces where gaseous exchange between the air and the blood can occur (see Figure 3).
- ✓ **Note:** The trachea, the two primary bronchi, and their primary branches resemble an inverted tree and are referred to as the **bronchi tree** or **bronchial tree**. By the time the branches of the bronchial tree have dwindled to form alveoli, only the internal surface layer of cells remains.



**OBJECTIVE 12**

**Major structures of the bronchi**



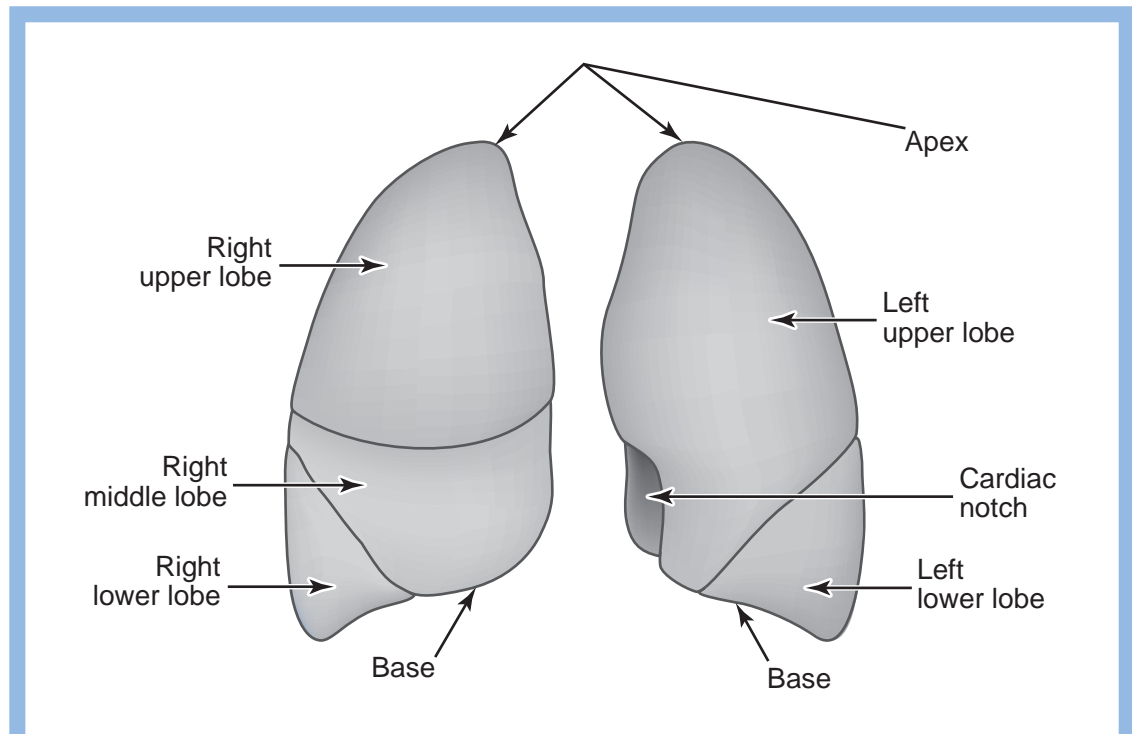
**Figure 3**  
Major structures of the bronchi

**OBJECTIVE 13****Characteristics and structures of the lungs****KEY TERMS**

**Medial** (me'-de-uhl)—Oriented toward the midline; being or occurring in the middle

**Mediastinal** (me-de-uh-sti'-nuhl)—Related to the mediastinum

- a. The two lungs rest side by side and extend from the diaphragm to a point slightly above the clavicles and lie against the ribs at the anterior and posterior (see Figure 2).
- b. The **medial** surface of each lung is concave to allow room for the **mediastinal** structures and the heart (see Figure 4).
- c. The lung root attaches to the mediastinum (see Figure 2) and is composed of all the structures entering and leaving the lung, including the primary bronchi, the pulmonary arteries and veins, the bronchial arteries and veins, the lymph vessels and nodes, and the nerves.
- d. The apex of a lung is the pointed upper margin that extends slightly above the clavicle (see Figure 2 and Figure 4).
- e. The base of a lung is the broad, inferior surface that lies on the diaphragm (see Figure 2 and Figure 4).
- f. The left lung has an indentation for the heart called the cardiac notch (cardiac depression) (see Figure 4).
- g. The right lung is slightly larger, heavier, and shorter (by about 1 inch [2.5 centimeters]) than the left lung.
- h. The right lung is divided into three lobes: the upper lobe, the middle lobe, and the lower lobe (see Figure 4).
- i. The left lung is divided into two lobes: the upper lobe and the lower lobe (see Figure 4).
- j. At birth, a person's lungs are pink, but with age they become a mottled-gray color due to the inhalation of dust, pollution, and smoke.
- k. When filled to capacity, a lung can hold approximately 275 cubic inches (4500 cubic centimeters) of air, though only 30 cubic inches (500 cubic centimeters) are inhaled and exhaled in a normal breath.
- l. The lungs act as an excretory organ in that a person loses about 24 cubic inches (400 cubic centimeters) of moisture per day in expired air.

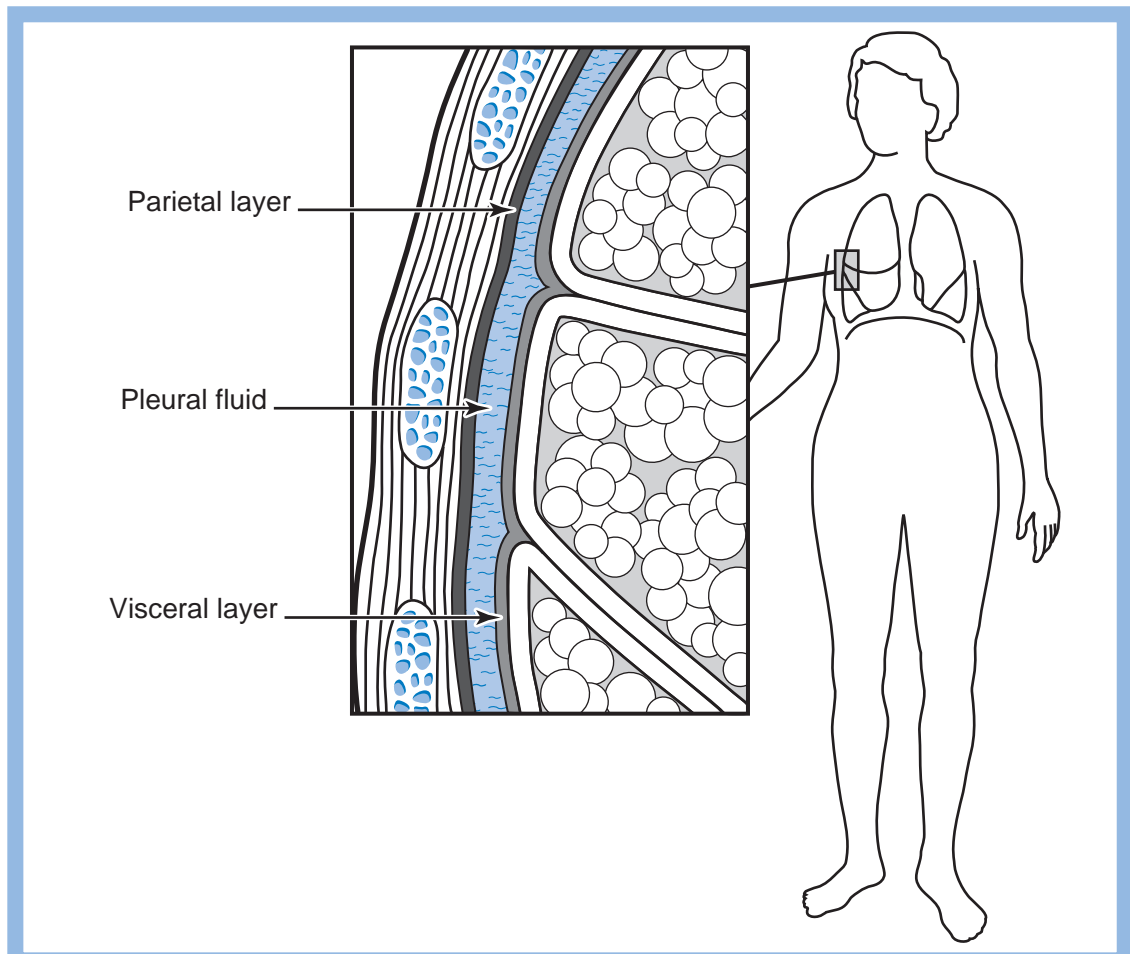
**OBJECTIVE 14****Major external structures of the lungs**

**Figure 4**  
Major external structures of the lungs

**OBJECTIVE 15****Characteristics and structures of the pleura****KEY TERM**

**Pleural effusion** (plur'-uhl i-fyu'-zuhn)—The collection of pleural fluid in the pleural space

- The pleura divides into the visceral pleura and the parietal pleura (see Figure 5).
- The visceral pleura covers the lung and dips into the fissures between the lobes.
- The parietal pleura lines the chest wall, covers the diaphragm, and reflects over the structures in the mediastinum.
- The parietal and visceral pleurae are separated from each other by a small amount of fluid—pleural fluid—that acts as a lubricant as the lungs expand and contract during respiration (see Figure 5).
- Pleural fluid is secreted by the serous membrane.
- Excess secretion of pleural fluid results in **pleural effusion**.

**OBJECTIVE 16****Major structures of the pleura**

**Figure 5**  
Major structures of the pleura

**OBJECTIVE 17****Muscles that change the size of the thorax**

- a. The diaphragm is the primary muscle of breathing.
- b. On inspiration, the diaphragm contracts, flattens, and moves downward to enlarge the thoracic cavity.
- c. On expiration, the diaphragm relaxes and moves upward to decrease the size of the thoracic cavity.
- d. The intercostal muscles (intercostals) are the secondary muscles of breathing.
- e. The intercostal muscles are designated as external and internal.
- f. The external intercostals elevate the ribs.
- g. The internal intercostals depress the ribs.



**OBJECTIVE 18****Common disorders and abnormalities of the respiratory system**

- ✓ **Note:** The respiratory system is subject to many conditions that differ from normal functioning. This is partially because the passages of the respiratory system are portals of entry for pathogens, toxins, and objects.
- a. Dyspnea (dis{p}'-ne-uh)—Painful, difficult, and labored respiration
  - ✓ **Note:** Normal respiration is referred to as **eupnea** (yup-ne'-uh).
- b. Hypernea (hi-puhr'-ne-uh)—An increased rate of respiration, often with deep inspirations
- c. Apnea (ap'-ne-uh)—The transient cessation of breathing
- d. Anoxia (a-nawk'-se-uh)—An abnormal condition characterized by a lack of oxygen
  - ✓ **Note:** Anoxia may be local or systemic and may be the result of an inadequate supply of oxygen to the respiratory system or of the inability of the blood to carry oxygen to the tissues.
- e. Hypoxia (hi-pawk'-se-uh)—The condition resulting from inadequate oxygen reaching the cells
- f. Suffocation (suh-fuh-ka'-shuhn)—An interruption in breathing with oxygen deprivation usually caused by an obstruction in the airways
  - ✓ **Note:** Suffocation may be accidental, intentional, or the result of a disease or of inadequate levels of respirable gases in the atmosphere.
- g. Asphyxia (as-fik'-se-uh)—A condition of increased carbon dioxide and decreased oxygen in the body as a result of diminished respiration
  - ✓ **Note:** Some of the more-common causes of asphyxia are drowning, electric shock, foreign objects in the respiratory tract, inhalation of toxic gas or smoke, and poisoning.
- h. Cheyne-Stokes (shayn' stoks') respiration (CSR)—An abnormal pattern of respiration characterized by alternating periods of apnea and deep, rapid breathing
  - ✓ **Note:** The respiratory cycle in CSR begins with slow, shallow breaths that gradually increase to abnormal depth and rapidity. Respiration gradually subsides as breathing slows and becomes shallower. Severe head injury, congestive heart failure, bronchopneumonia, or other respiratory diseases may induce CSR.
- i. Cyanosis (si-uh-no'-suhs)—The condition characterized by bluish-gray discoloration of the skin and mucous membranes as a result of insufficient oxygen

- j. Deviated nasal septum (de'-ve-at-uhd na'-zuhl sep'-tuhm)—A shift in the partition of the nasal cavity
- ✓ **Note:** The nasal septum commonly shifts to the left during normal growth, but the condition is often aggravated by a blow to the nose or other trauma. A severely deviated septum may result in obstruction of the nasal passages, leading to infection, sinusitis, shortness of breath, headache, and nosebleeds.
- k. Asthma (az'-muh)—A respiratory disorder characterized by constriction of the bronchioles, excessive production of mucus, and difficult breathing
- ✓ **Note:** Episodes of asthma are characterized by wheezing on expiration and inspiration and coughing. The episodes may be triggered by inhalation of allergens or pollutants, infection, cold air, vigorous exercise, or emotional stress.
- l. Emphysema (em{p}-fuh-ze'-muh)—The deterioration of alveoli and reduced elasticity of the lungs, leading to impairment of normal gas exchange
- ✓ **Note:** When emphysema occurs early in life, it is usually the result of a rare genetic deficiency. Acute emphysema may be caused by bronchopneumonia, suffocation, and whooping cough. Chronic emphysema usually accompanies chronic bronchitis, a major cause of which is cigarette smoking.
- m. Hyaline (hi'-uh-luhn) membrane disease—A condition in premature infants whose lungs have not developed enough to allow inflation of the alveoli
- ✓ **Note:** Hyaline membrane disease is also called **respiratory distress syndrome of the newborn** (RDS).
- n. Laryngeal (luh-rin'-je-uhl) edema—A condition in which fluid accumulates around the vocal cords
- ✓ **Note:** The condition is also called **edema of the glottis**, which is usually inflammatory and may result from an infection, injury, or inhalation of toxic gases.
- o. Pulmonary edema—A condition in which fluid accumulates in lung tissues and in the alveoli
- ✓ **Note:** Pulmonary edema is caused most commonly by congestive heart failure but also occurs in barbiturate and opiate poisoning, infections, renal failure, and after a stroke, skull fracture, near drowning, and inhalation of irritating gases.
- p. Pneumonia (nu-mo'-nyuh)—An acute inflammation of the lungs usually caused by a bacterial infection
- ✓ **Note:** Pneumonia may also be caused by viruses, rickettsiae, or fungi.
- q. Pneumothorax (nu-muh-thor'-aks)—A collection of air or gas in the pleural space causing the lung to collapse
- ✓ **Note:** Pneumothorax may be the result of an open chest wound that permits the entrance of air, a rupture on the surface of a lung, or a severe bout of coughing.

## Module 11-B: Respiratory System

- r. Respiratory distress—Any of various conditions in which the mechanics of respiration fail to inflate the alveoli
- s. Upper respiratory infection—An infection of the mucosa of the nose, pharynx, or larynx
- t. Rhinitis (ri-ni'-tuhs)—An inflammation of the mucous membranes of the nasal cavities generally accompanied by swelling of the mucosa and a nasal discharge
  - ✓ **Note:** Rhinitis may be acute, allergic, atrophic, or vasomotor, and it may also be called **coryza** (kuh-ri'-zuh).
- u. Pharyngitis (far-uhn-ji'-tuhs)—An inflammation or infection of the pharynx, usually causing symptoms of a sore throat
- v. Laryngitis (lar-uhn-ji'-tuhs)—An inflammation or infection of the larynx, usually accompanied by edema of the vocal cords with hoarseness or loss of the voice
- w. Bronchitis (brawn-ki'-tuhs)—An acute or chronic inflammation of the bronchial tree, often as a result of infection
- x. Tuberculosis (tu-buhr-kyuh-lo'-suhs) (TB)—A chronic, highly contagious infection of the lungs from the bacillus *Mycobacterium tuberculosis*
- y. Lung cancer—A malignancy seated in the pulmonary tissue, generally affecting lungs damaged by disease, pollutants, or smoking



OBJECTIVE 19

**Assignment Sheet 1—Practice Critical Thinking:  
Investigate Lung-Transplant Procedures**

Name \_\_\_\_\_ Date \_\_\_\_\_

Evaluation criteria	Rating
• Directions were followed	_____
• Investigative report followed agreed-upon format	_____
• Investigative report met agreed-upon criteria	_____
<b>Overall rating</b>	_____

Evaluator’s comments \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

INTRODUCTION

As a surgical technician, you may become involved in a number of procedures that involve the lungs—directly or indirectly. Surgery to correct disorders of the airway and lungs due to injury, cancer, tuberculosis and other diseases are fairly common and often critical. Complications of other types of surgical procedures often involve the lungs, including various forms of pneumonia. Consequently, surgical technicians need to be familiar with the surgical procedures that address the respiratory system.

The Web sites listed below provide information about lung transplants. This procedure involves the removal of a lung from a deceased donor and its surgical implant in a recipient. The procedure may be required to replace a lung that has been damaged by disease or injury. These Web sites and others that your instructor may provide you offer lots of useful information about the procedure.

- \*<http://www.chestsurg.org/>
- <http://www.columbiasurgery.org/pat/lungtx/index.html>
- <http://www.hopkinsmedicine.org/transplant/Programs/lung/>
- <http://www.lungusa.org/site/pp.asp?c=dvLUK9O0E&b=23012>

You will review the Web sites above and other resources to determine information related to

lung transplants.

\*Web-site addresses were accurate and all content on referenced Web sites was appropriate during development and production of this product. However, Web sites sometimes change; MAVCC takes no responsibility for a site's content. The inclusion of a Web site does not constitute an endorsement of that site's other pages, products, or owners.

**EXERCISE**

**ACTIVITY  
CHECKLIST**

Put an "X" on the blank line before each activity below as you complete it.

- \_\_\_\_\_ 1. Review the objectives in the Information Sheet.
- \_\_\_\_\_ 2. Read the investigation points on the next page. Your investigative report must include answers to all of these investigation points.
- \_\_\_\_\_ 3. Check with your instructor to determine the format (written report, PowerPoint presentation, poster, etc.) your instructor wants you to follow in completing your investigative report. Describe that format on the blanks provided below.
- \_\_\_\_\_ 4. Check with your instructor to agree upon the criteria he or she will use to evaluate your investigative report. Describe those criteria on the blanks provided below.
- \_\_\_\_\_ 5. Complete your investigation and give your investigative report to your instructor for evaluation.

Format of investigative report:

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Evaluation criteria:

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**INVESTIGATION  
POINT 1**

List and explain some of the reasons a person might be a candidate for a lung transplant.

**INVESTIGATION  
POINT 2**

Describe some of the evaluations that may be made on a patient who may be a candidate for a lung transplant.

**INVESTIGATION  
POINT 3**

The Web sites listed in the introduction to this assignment discuss a number of factors related to the rejection of a transplanted heart. Briefly explain the general cause of rejection and state what can be done to overcome it. Also, assess the potential for rejection in general and as related to specific conditions that may require lung transplants.

**INVESTIGATION  
POINT 4**

In some cases the transplant procedure will not be successful due to other complications, such as infections, damage to the transplanted organ, and similar factors. Choose one of the complications presented in the resource websites or one assigned by your instructor. Discuss the nature of the complication, its likelihood of occurrence, factors that may promote or prevent its occurrence, and treatment for the complication.

**INVESTIGATION  
POINT 5**

Based on the information that you have studied in the available resources, what recommendations should be made to a 58-year-old male smoker with emphysema in both lungs but who is otherwise healthy? Is a lung transplant in order? Why or why not?



## Answers to Assignment Sheet

### Assignment Sheet 1—Practice Critical Thinking: Investigate Lung-Transplant Procedures

Suggested answers

#### INVESTIGATION POINT 1

The student's answer should include several of the following end-stage lung diseases and related problems: obstructive lung disease, cystic fibrosis, pulmonary hypertension, pulmonary fibrosis, emphysema, sarcoidosis, eosinophilic granuloma, extrinsic allergic alveolitis, lymphangioleiomyomatosis, and severe bronchiectasis.

#### INVESTIGATION POINT 2

Tests may include blood tests; urine, stool, and sputum samples; tests to evaluate the status of the lung disease and the condition of the patient's heart, such as a chest X ray, a chest CT scan, a ventilation/perfusion scan, and echocardiogram, and electrocardiogram and a radionuclide ventriculogram; possible cardiac catheterization to ensure that there are not blockages to blood flow to the heart and also to measure the blood pressure in the pulmonary arteries; and tests for arterial blood gases and pulmonary function tests.

#### INVESTIGATION POINT 3

Rejection is basically the response of the immune system to what it perceives as a foreign organism in the implanted organ. There are anti-rejection drugs that help reduce the immune response. Rejection response will occur in virtually all transplants. In approximately 50 percent of the cases, rejection cannot be overcome with medication. Rejection tends to be less common in conditions such as obstructive lung disease.

#### INVESTIGATION POINT 4

Answer will depend on the complication chosen or assigned.

#### INVESTIGATION POINT 5

The answer will depend on the student's interpretation of the data presented by the various sites. Key points that the student should make are that the patient should stop smoking. Second, if a transplant is performed, it is a treatment and not a cure. Factors that contributed to the emphysema may still be present in the patient's life and some effects are irreversible. Students may choose to point out that preparatory tests may reveal reasons for not doing the procedure.