Respiratory System

LEARNING OBJECTIVES

- Define at least 10 terms referring to the respiratory system.
- Describe the three functions of the respiratory system.
- Identify at least 10 respiratory system structures and the function of each.
- Describe at least three methods of assessment of the respiratory system.
- Describe at least five disorders of the respiratory system.

KEY TERMS

Apnea (AP-nee-uh) Cessation of breathing
Bradynea (brayd-IP-nee-uh) Abnormally slow rate of breathing
Chronic (KRON-ik) Persisting over a long period of time
Cilia (SIL-ee-uh) Hairlike projections from the surface of a cell
Dysphagia (dis-FAY-gee-uh) Difficulty swallowing
Dyspnea (DISP-nee-uh) Difficult or labored breathing
Eupnea (YOOOP-nee-uh) Easy or normal breathing
Expiration (ek-spith-RAY-shun) Act of breathing out, exhalation
Inspiration (in-spith-RAY-shun) Act of drawing air into the lung, inhalation
Mediastinum (mea-dee-uh-SHE-num) Thoracic space between the two lungs
Phlegm (flem) Thick mucus secreted by the tissues in the respiratory passages and usually discharged through the mouth
Pulmonary (PUL-mo-ray-ee) Pertaining to the lungs
Respiration (res-pith-RAY-shun) Exchange of oxygen and carbon dioxide between the atmosphere and the cells of the body, also called ventilation
Tachypnea (taak-IP-nee-uh) Excessively fast respiration
Respiratory System Terminology

A tracheotomy and endotracheal intubation may be used to temporarily open the airways, but a tracheotomy is more permanent. (From Patton KT, Thibodeau GA: Anatomy & physiology, ed 7, St. Louis, 2010, Mosby.)

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
<th>Prefix</th>
<th>Root</th>
<th>Suffix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apnea</td>
<td>Without breathing</td>
<td>a</td>
<td>pnea</td>
<td></td>
</tr>
<tr>
<td>Bronchitis</td>
<td>Inflammation of the bronchus</td>
<td>dys</td>
<td>bronch</td>
<td>itis</td>
</tr>
<tr>
<td>Dysphagia</td>
<td>Difficulty swallowing</td>
<td>.eu</td>
<td>phag</td>
<td>ia</td>
</tr>
<tr>
<td>Eupnea</td>
<td>Normal breathing</td>
<td>eu</td>
<td>pnea</td>
<td></td>
</tr>
<tr>
<td>Laryngitis</td>
<td>Inflammation of the voice box</td>
<td>laryng</td>
<td></td>
<td>itis</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>Inflammation of the lung</td>
<td>pleur</td>
<td>laryng</td>
<td>itis</td>
</tr>
<tr>
<td>Pneumonec</td>
<td>Removal of the lung</td>
<td>pneumon</td>
<td>ectomy</td>
<td></td>
</tr>
<tr>
<td>Tachypnea</td>
<td>Fast respiration</td>
<td>tachy</td>
<td>pnea</td>
<td></td>
</tr>
<tr>
<td>Tonsillitis</td>
<td>Inflammation of the tonsils</td>
<td>tonsill</td>
<td>itis</td>
<td></td>
</tr>
<tr>
<td>Tracheotomy</td>
<td>Incision into the windpipe</td>
<td>trache</td>
<td>Otomy</td>
<td></td>
</tr>
</tbody>
</table>

* A transition syllable or vowel may be added to or deleted from the word parts to make the combining form.

Abbreviations of the Respiratory System

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABG</td>
<td>Arterial blood gases</td>
</tr>
<tr>
<td>BS</td>
<td>Breath sounds</td>
</tr>
<tr>
<td>CF</td>
<td>Cystic fibrosis</td>
</tr>
<tr>
<td>CO₂</td>
<td>Carbon dioxide</td>
</tr>
<tr>
<td>COPD</td>
<td>Chronic obstructive pulmonary disease</td>
</tr>
<tr>
<td>ENT</td>
<td>Ears, nose, and throat</td>
</tr>
<tr>
<td>TB</td>
<td>Tuberculosis</td>
</tr>
<tr>
<td>TCDDB</td>
<td>Turn, cough, deep breath</td>
</tr>
<tr>
<td>Trach</td>
<td>Tracheotomy</td>
</tr>
<tr>
<td>URI</td>
<td>Upper respiratory infection</td>
</tr>
</tbody>
</table>

Structure and Function of the Respiratory System

The respiratory system brings oxygen into the body through the breathing process. With inspiration, or inhaling air, oxygen is brought into the lungs. With expiration, or exhalation, carbon dioxide is removed from the lungs.

The respiratory system functions in three ways:
- It exchanges gases between the blood and the lungs.
- It helps regulate body temperature by cooling or warming the blood.
- It helps maintain the blood’s electrolyte balance.

TABLE 13-1
Breathing Reflex Actions

<table>
<thead>
<tr>
<th>Reflex</th>
<th>Cause</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cough</td>
<td>Irritation to the trachea or bronchi</td>
<td>Epiglottis and glottis close, muscles raise pressure in lungs, and then they open, releasing a burst of air to remove foreign matter. Heart and breathing rate slow, blood diverted to the brain, heart, and lungs until breathing resumes.</td>
</tr>
<tr>
<td>Diving</td>
<td>Submersion in cold water</td>
<td>Deep inhalation of air through mouth</td>
</tr>
<tr>
<td>Gasp</td>
<td>Sudden sensation (cold, surprise, pain, sleep apnea)</td>
<td>Rib muscles and diaphragm contract, causing rapid inhalation</td>
</tr>
<tr>
<td>Hiccup</td>
<td>Cause unknown, lack of sleep, overeating or drinking, stress, chronic hiccup may indicate tumor or laryngitis</td>
<td>Eyes and nasal passages secrete fluid, diaphragm causes large breath to be inhaled, followed by contraction of chest muscles to push air out of nose and mouth</td>
</tr>
<tr>
<td>Sneeze</td>
<td>Irritation of nasal passages, respiratory illness, allergy, can be exposure to bright light (genetic)</td>
<td>Small audible inhalations with little exhalation Mouth opens wide to take in deep breath; air is released after lungs are expanded to capacity.</td>
</tr>
<tr>
<td>Sniff</td>
<td>Identify smell, nasal congestion</td>
<td></td>
</tr>
<tr>
<td>Yawn</td>
<td>Bored, tired, stress (hypotheses include low oxygen content in blood, regulation of brain temperature, muscle stretching)</td>
<td></td>
</tr>
</tbody>
</table>

There are three processes of respiration:
- External respiration, or ventilation, brings oxygen into the lungs.
- Internal respiration exchanges oxygen and carbon dioxide between blood and body cells.
- Cellular respiration changes carbohydrates among substances in cells. Both the voluntary and involuntary nervous systems control respiration. The body chemically regulates the rate (how fast the breaths are) and depth (how deep they are). If the concentration of gases in the blood changes, the brain adjusts respiratory rate and depth to counteract the changes to maintain homeostasis (Table 13-1).

Air enters the respiratory system through the nose (nasal cavity). The nasal cavity is lined with hairs called cilia to help filter out any foreign particles.

Brain Byte

Nose is take breath. This can be demonstrated by breathing onto a mirror and observing the size of the condensation.

It also helps to warm and moisten the air. Air also enters through the mouth (oral cavity), when the nasal cavity is blocked. The tonsils and adenoids at the back of the throat help the body resist infection. The sinuses are hollow spaces in the bones of the skull that open into the nasal cavity. Sinuses help regulate the temperature of air before it reaches the sensitive lungs. They also humidify and filter the air.

The air from the nose or mouth is then funneled through the throat (pharynx) and into the windpipe (trachea). The trachea is divided into three segments: nasopharynx (nose), oropharynx (mouth), and laryngopharynx (larynx).

The trachea extends from the trachea as an alternative method for the exchange of gases (tracheotomy). The voice box (larynx) is located below the pharynx. Voice sounds are made when air moves through it. A flap of tissue called the epiglottis covers the voice box or larynx during swallowing to prevent food and liquid from entering the bronchi and lungs. The larynx also contains the opening for tubes through which air reaches the middle ear to adjust for pressure changes (eustachian tubes).

The trachea branches into two tubes called bronchi. Each bronchus enters one of the lungs and then
During breathing, muscles lift and separate the ribs to help the lungs expand. The diaphragm is a large, flat muscle that separates the thoracic cavity from the abdominal cavity. The diaphragm contracts and moves downward during inhalation. This creates suction, and air is pulled in from outside the body. Exhalation occurs when the diaphragm relaxes (Fig. 13-2).

**Assessment Techniques**

Different indicators of respiratory function can be assessed. These include the respiration rate, character, sounds, lung volume, and blood gases.

**Rate**

The normal rate of respiration varies with age, gender, posture, exercise, temperature, and other factors. Children breathe more than 20 times per minute, adults breathe 16 to 20 times per minute, and older adults often breathe fewer than 16 times per minute. Normal respiration is called eupnea. Painful or difficult respiration is dyspnea. Tachypnea is an abnormal respiratory rate greater than 24 per minute, and bradypnea is fewer than 10 per minute.

**Character**

Respirations should have a regular rhythm, occurring at regular intervals. Irregular rhythms of respirations may occur in different patterns, such as a rapid series followed by a pause or by no respiration, called apnea. Respirations may also be dry, which is normal, or wet. They can also be characterized as deep or shallow.

**Sounds**

Breath sounds can be heard by using a stethoscope. The quality of the sound varies with the location of the stethoscope over the bronchial tree but should be dry and clear. Wheezing or other abnormal or misplaced (adventitious) sounds in the upper respiratory tract may indicate an abnormal condition.

**Lung Volume**

The amount of air that can be brought into the lungs is called respiratory capacity. It is measured using a spirometer (Fig. 13-3). Lung capacity depends on age and physical condition. The measurement of respiratory capacity is called lung volume (Fig. 13-4). The vital capacity includes the tidal volume, inspiratory reserve, and expiratory reserve.

The tidal volume is the amount of air normally exchanged with each cycle of inspiration and expiration.
tion. Inspiratory reserve is an additional amount of air that can be inhaled with conscious effort. Expiratory reserve is the additional amount of air that a person can exhale beyond the normal amount with conscious effort.

The sum of these three values is called the vital capacity. This is the total amount of air that can be exchanged by that person. A certain amount of air is always in the lungs to maintain their shape. This is called the residual volume.

**Blood Gases**

Blood gas studies measure the amount of gases such as oxygen (O₂) and carbon dioxide (CO₂) in the blood and the blood’s pH. These tests provide an accurate assessment of respiratory function (Table 13-2).

**DISORDERS OF THE Respiratory System**

*Anthrax* (AN-thraz) occurs naturally and is caused by spores of the bacteria *Bacillus anthracis*. The spores may be present in the soil for years and occasionally infect grazing animals. In humans, anthrax may appear as an infection of the skin, digestive system, or respiratory system. Inhalation anthrax has a death rate of more than 80%. In 2001 anthrax spores were sent through the U.S. postal system as a type of biological terrorism, which resulted in the death of 5 people. A vaccine for anthrax has been developed and is available to special military units and researchers. After exposure, early treatment with antibiotics may prevent infection.

*Asthma* (AZ-thma) is a chronic condition that can be life threatening. According to the American Academy of Allergy, Asthma, and Immunology, 10 million Americans have allergic asthma. Its cause is not completely understood, although an antibody produced by exposure to an allergen causes the symptoms. Therefore the conventional belief is that asthma is an allergic reaction. However, some studies indicate that cells in the airway may trigger the attack, not the immune system. Asthma attacks may result from exposure to an allergen, cold temperature, exercise, or emotion (Box 13-1). The bronchi narrow and contract in spasms, and the affected person may experience wheezing and difficulty exhaling. Treatment includes relaxation and medication to clear air passages. If the cause is determined to be the airway cells, treatment might include inhalation of genes that stop the reaction. Although there is no known cure for asthma, half of all children with asthma outgrow the condition by their teens.

**BOX 13-1**

**Triggering Agents of Asthma**

- Air pollution
- Cockroaches
- Cold
- Dust mites
- Emotion
- Exercise
- Foods or food additives
- Humidity
- Mold
- Pets
- Secondhand smoke

**CASE STUDY 13-1**

Your friend tells you that he always thinks he has asthma because he feels a shortness of breath and stuffy nose in the cold weather. What should you say?

Answers to Case Studies are available on the Evolve website: http://evolve.elsevier.com/Gerlin

**Atelectasis** (at-uh-LEK-tuh-sis) is collapse of part or all of a lung caused by a tumor in the thoracic cavity, pneumonia, or injury. The person feels severe pain and shortness of breath, or dyspnea. Treatment corrects the cause and reexpands the lung with pulmonary suction.

**Bronchitis** (brong-KYE-tis) is an infection of the bronchi. Inflammation causes the bronchial walls to thicken, and less air can be exchanged. Bronchitis often results in a heavy cough and much mucus eliminated as sputum. Treatment may include the use of expectorant medications and postural drainage.

**Carbon monoxide poisoning** usually occurs from breathing carbon monoxide from automobile exhaust fumes. Breathing too much carbon monoxide can be life threatening because the carbon monoxide takes the place of oxygen on hemoglobin molecules. With no place for oxygen on the hemoglobin, the body cells do not receive it. Carbon monoxide poisoning first causes nausea and drowsiness. The person should be removed from the area of the gas, and oxygen should be administered.

**Brain Byte**

Carbon monoxide is the leading cause of accidental poisoning deaths in America.

**Chronic obstructive pulmonary disease (COPD)** is a group of chronic respiratory disorders that includes asthma, chronic bronchitis, and pulmonary emphysema. These conditions have similar symptoms and treatments. The symptoms include shortness of breath (dyspnea) and tissue voegrowth called *hyperventilation* (hi-per-VEN-tih-LAY-shun). Treatment includes giving oxygen; an antidiuretic (an-tie-di-ur-ET-ik), a medication used to increase the amount of fluids excreted by the body, and a bronchodilator (brong-koh-di-LAY-tor), a medication used to dilate the bronchi and bronchioles for easier breathing.
A cold is a respiratory infection caused by one of more than 200 viruses. It lasts from 1 to 2 weeks. It may cause a sore throat, sneezing, aches, pains, a runny nose, and fever. Cold medications may relieve the symptoms, but there is no cure.

**CASE STUDY 13-2** Your friend tells you that he cannot catch your cold because he had one a few months ago. What should you say?

**Answers to Case Studies are available on the Evolve website:** [http://evolve.elsevier.com/Gerdin](http://evolve.elsevier.com/Gerdin)

**CASE STUDY 13-3** Your friend’s baby is 1 year old and has a cold. Your friend asks you what over-the-counter medication you should give the baby. What should you say?

**Answers to Case Studies are available on the Evolve website:** [http://evolve.elsevier.com/Gerdin](http://evolve.elsevier.com/Gerdin)

Cystic fibrosis (SIH-tik fie-BRO-sis) is a genetic disorder of the exocrine (EK-so-krin) glands, usually diagnosed before the age of 3. The mucus in the respiratory system becomes thicker (more viscous), and excess salt appears on the skin. Cystic fibrosis requires intensive pulmonary care to prevent chronic disorders. With consistent treatment, people with cystic fibrosis may live for 30 or more years.

Emphysema (em-fuh-SEE-ma) results when the alveoli lose elasticity, usually after 50 years of age. The alveoli become dilated and do not exchange gases well. Emphysema can result from smoking or several disorders of the respiratory system. Treatment includes use of "pursed lip breathing," the very slow exhalation of air to allow alveoli to respond.

**Hanta virus** (HAN-tuh-ruh-sis) is a respiratory condition spread by breathing in materials contaminated by urine or saliva of infected rodents such as deer, mice, and chipmunks. The symptoms appear like influenza and include fever, cough, muscle aches, and inflamed, reddened eyes. This virus has a rapid onset and is often fatal. Treatment is supportive to assist the infected person with respiratory function.

**Hantavirus** is a respiratory infection caused by allergens such as plants, dust, and food. It may cause headache, nausea, and watery drainage from the eyes and nose. Treatment includes medication for the symptoms or desensitization therapy.

**Lung cancer** is directly linked to smoking and smoke products (Fig. 13-5). The American Cancer Society reports that lung cancer is the leading cause of cancer-related deaths in both men and women. The cancer is usually not detected until it is widespread. The cancer may spread to many parts of the body through the lymph nodes. Treatment may include surgical removal of lung segments, as well as chemotherapy and radiation.

**Plural effusion** (PLUR-uhl e-FYOO-uh-zhun) is a condition in which air or fluid enters the pleural cavity. The space for respiration becomes limited. Pleural effusion is usually caused by cancer, infection, or congestive heart failure. The person with pleural effusion may feel shortness of breath and pain. Treatment may include thoracostomy (tho-rah-kohs-TOE-sis), which removes the fluid with a needle or a suction drainage tube.

**Pleurisy** (PLOO-reh-sis) is an inflammation of the membranes that line the lungs. It is usually a complication of a severe respiratory infection such as pneumonia. The person with pleurisy experiences difficulty breathing; pain; and grating breath sounds, also known as crepita (KREP-ih-tus).

**Pneumonia** (pyoo-NEE-muh-nee-uh) is an inflammation of the lungs, in which a buildup of excessive moisture impairs breathing. Bacteria, viruses, or chemical irritants may be the causative agents of pneumonia. When a foreign substance, such as vomitus, causes it by entering the respiratory passage, it is called aspiration pneumonia. Treatment is directed at the original cause and includes medication to decrease the moisture.

**Pneumocystis carinii** (nyoo-moh-KES-tis kah-REE-nee) is an inflammation in the lungs caused by inhaled irritants. These may include dust, asbestos, sand, iron, and coal particles (Fig. 13-6). The lungs may have excessive fluid, and the person feels shortness of breath.

**Respiratory acidosis** (RES-per-uh-ak-soe-sis) is a buildup of carbon dioxide in the blood, causing a lowered blood pH. The condition may result from COPD or drug overdose. The person with respiratory acidosis may experience decreased mental functioning or delusions (delirium); death may also result. Treatment may include giving oxygen or providing ventilation with a respirator.

**Respiratory alkalosis** (RES-pir-uh-alkal-oh-sis) is a deficiency of carbon dioxide in the blood. It is most often caused by hyperventilation, or rapid breathing, resulting from anxiety or exercise at high elevations. The person with respiratory alkalosis experiences extreme nervousness, tingling in the extremities, and muscle spasms (tetany). It is rarely life threatening. Treatment involves breathing slowly or breathing into a paper bag. These techniques increase the carbon dioxide level in the blood.

**CASE STUDY 13-4** Your friend tells you that he gets a "itch" or sharp pain in his side when he runs. He says he won’t keep running because it hurts too much. What should you say?

**Answers to Case Studies are available on the Evolve website:** [http://evolve.elsevier.com/Gerdin](http://evolve.elsevier.com/Gerdin)

Respiratory distress syndrome is a condition that occurs when the alveoli do not inflate properly. Adult respiratory distress syndrome may result from inhaling foreign substances and swelling (edema) of respiratory tissues. Infant respiratory distress syndrome (RDS) is one of the leading causes of death in premature births. According to the National Institutes of Health, RDS affects 10% of premature infants. Treatment is the delivery of oxygen and in infants, application of surfactant through tubes into the lungs.

**Sinusitis** (sin-uhs-us-tis) is an inflammation of one or more of the paranasal sinuses. It can result as a complication of an upper respiratory or dental infection or changes in atmosphere, such as in swimming or air travel. Symptoms include pain, pressure, headache, fever, and increased secretions. Treatment includes nasal decongestants, steam inhalations, and antibiotics if infection is present.

**Brain stem** Since 2005 the Patriot Act has required a signature and identification for purchase of over-the-counter nasal decongestant remedies that contain pseudoephedrine.

**Sudden infant death syndrome (SIDS)** is a respiratory disorder of newborns. More than 2500 infants in the United States die of SIDS each year. The SIDS diagnosis is given for the sudden death of an infant younger than 1 year of age that remains unexplained after a complete investigation. SIDS may be called crib death because it often occurs while the infant is sleeping. The cause of SIDS may be related to a defect in a part of the brain, but environmental and metabolic factors are also considered risk factors. Infants who are at high risk for SIDS may be monitored with heart and respiratory devices while sleeping. One new technique to prevent death is
Tuberculosis (tub-ber-kyoo-LO-sis) (TB) caused by bacteria that are difficult to destroy, is transmitted through the air. It leads to excessive sputum production and coughing. Since 1991 more cases of tuberculosis have developed than in all previous time. The Centers for Disease Control and Prevention (CDC) reports that the reduction in rate in 2000 and 2004 was the lowest since national reporting began in 1953. It is the most common fatal infectious disease in the world today. Recently a strain of the bacteria that is resistant to the medications used previously has evolved, and the incidence of this strain of infection is currently increasing. Treatment includes medication for up to 2 years and may require surgical removal of the affected tissue to destroy the bacteria. Respiratory isolation may be necessary to prevent the spread of tuberculosis.

Upper respiratory infections (URI) are caused by a virus or bacteria in the nose, pharynx, or larynx. Pharyngitis (far-e-nin-IT-iss) is a sore throat often accompanied by difficulty in swallowing (dysphagia). Laryngitis (lar-e-ning-IT-iss) may cause hoarseness or loss of voice. Tonsillitis (ton-sil-IT-iss) is painful inflammation of the lymph nodes and may require surgical removal of the tonsils. Treatment for all types of upper respiratory infections includes rest and medication to relieve pain, reduce fever, and combat the cause of the infection.

### Issues and Innovations

#### Tobacco Issues

Cigarette smoking has been linked to many illnesses, such as heart disease and cancer. Research shows that nonsmokers subjected to “passive,” “secondhand,” or “side-stream” smoke from the cigarettes of other people also face these risks. The CDC considers smoking to be the leading preventable cause of death in the United States. It estimates that more than 20% of adult Americans smoke cigarettes.

Studies have demonstrated that a person who works in a restaurant or bar where smoking is permitted has a 39% greater chance of developing lung cancer than someone who does not. The American Lung Association has reported that 20% of the U.S. population is at risk of developing lung disease from secondhand smoke. The U.S. Department of Health, Education, Welfare, and Public Health Services reports that secondhand smoke has higher levels of tar, nicotine, and carbon monoxide than that inhaled by the direct smoker.

The federal Environmental Protection Agency has classified secondhand smoke as a group A carcinogen, along with asbestos and radon. In many regions, laws restrict smoking to designated areas to protect nonsmokers from exposure to the smoke. Insurance companies often have higher rates for smokers because of the greater health risks and problems of safety. Smoking has been an issue used to determine custody in divorce settlements.

Some advertisements of “smokeless” tobacco, such as chew or tobacco powder, imply that it does not involve the same health risks; however, placing smokeless tobacco between the lower lip and teeth (dipping) is actually as dangerous as smoking and perhaps more so because the juice from tobacco causes a change in mouth tissue called leukoplakia (LOO-kay-PLA-kay-uh). These white, leathery patches become mouth cancer in 5% of cases (Fig. 13-7). Damage to the taste buds on the tongue affects a person’s sense of taste. Tobacco and the sweeteners in the smokeless tobacco products also damage the gums, causing the teeth to decay and fall out.

Cancer may develop in the esophagus if the tobacco juices are swallowed. Ulcers may occur in the stomach from increased production of gastric acid. The nicotine habit develops with smokeless tobacco just as with cigarette smoking. Heart disease may result from an increase in blood pressure and heart rate. Cancer of the bladder, pancreas, and kidney has been shown to occur more often in those using smokeless tobacco.

#### Environmental Health Risks

Various inhaled inorganic substances can be hazardous to one’s health. For example, miners who inhale coal dust develop black lung disease (pneumoconiosis) or silicosis. Inhalation of asbestos leads to chronic scarring of the lung tissue. Berylliosis can result from inhalation of beryllium used in fluorescent light bulbs and the aerospace industry.

Inhalation of biological contaminants such as bacteria, fungi, and dust mites can lead to allergic rhinitis. Other items of concern in the environment include pesticides, particulates in air pollution, and combustible gases. New environmental risks are continually being identified. The American Lung Association reports that occupational lung disease is the major reason for lost workdays and loss of productivity in the United States. It considers occupational asthma to be the most common form of occupational lung disease.

In a long-term study of 45 different neighborhoods, three areas in Pennsylvania were found to have three times the usual rate of lung cancer. In these areas a high level of sulfur dioxide was found in the air. These studies have implicated the power plants as the source of the sulfur dioxide. A study released by the Maryland Nurses Association in 2006 links 700 premature deaths, 30,000 asthma attacks, and 400 pediatric emergency department visits to the pollution from power plants yearly.

In the Silicon Valley area of California, hundreds of workers experienced symptoms apparently resulting from exposure to toxic chemicals used in the computer industry. The symptoms experienced include hypersensitivity to ordinary chemicals, memory loss, fatigue, impaired concentration, and violent mood swings.

Sick building syndrome includes several environmental conditions that can lead to sickness. Most often, sick buildings do not have windows that open to the outside, and their heating and cooling ducts start at a common source. An elevated level of carbon dioxide in the building causes sickness. Specific types of sick building syndrome include “air-conditioner lung” and “humidifier fever.”

Exposure to “toxic mold” has been determined to be a health hazard for perhaps hundreds of thousands of affected people. Although the mold itself is not toxic, some molds such as Stachybotrys or Chaetomium produce mycotoxins that are poisonous. Exposure to molds may cause anything from a minor allergic reaction to more serious conditions including chronic bronchitis, heart problems, and learning disabilities.

### Summary

- Functions of the respiratory system include exchanging gases between the blood and lungs, regulating body temperature, and maintaining electrolyte balance.
- Structures of the respiratory system include the nasal cavity, lungs, bronchi, alveoli, and diaphragm.
- Methods of assessment of the respiratory system include respiration rate, character, breath sounds, lung volume, and blood gases.
- Disorders of the respiratory system include asthma, atelectasis, bronchitis, chronic obstructive pulmonary disease, and cystic fibrosis.

### Review Questions

1. Describe the three functions of the respiratory system.
2. Describe the function of each of the following structures of the respiratory system: Epiglottis, Sinus, Pleura, Tonsil.
3. Describe three tests used to assess the function of the respiratory system.
4. Describe five body systems that are affected by the use of tobacco in any form.
5. Describe two health hazards that have been attributed to inhalation of environmental materials.

**Critical Thinking**

1. Investigate the rate of tobacco use by adolescents. Design a brochure for middle school-age children about the hazards of using tobacco.
2. Investigate at least five common medications used in treatment of respiratory system disorders.
3. List at least five occupations involved in the health care of respiratory system disorders.
4. Investigate the current research being conducted about respiratory disorders that result from environmental factors.
5. Research and review an article regarding a recent development or treatment method relating to the respiratory system.

**Explore the Web**

**Cystic Fibrosis**

Cystic Fibrosis Foundation
http://www.cf.org/treatments/Therapies/

National Heart Lung and Blood Institute

**Tobacco**

KidsHealth
http://kidshealth.org/teen/drug_alcohol/tobacco/smokeless.html

CDC
http://www.cdc.gov/tobacco

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**Skeletal System**

**LEARNING OBJECTIVES**

- Define at least 10 terms relating to the skeletal system.
- Describe the five functions of the skeletal system.
- Identify at least 10 structures of the skeletal system.
- Identify at least three methods of assessment of the skeletal system.
- Describe at least five disorders of the skeletal system.

**KEY TERMS**

- Articulation (ar-tik-yo-LAY-shun) Joint: place of junction between two bones
- Bursa (BER-sah) Sacklike cavity filled with fluid to prevent friction
- Cancellous (KAN-seh-lus) Spongy or latticelike structure
- Cartilage (KAR-tih-laj) Specialized, fibrous connective tissue
- Collagen (KOL-uh-jen) White protein fibers of the skin, tendons, bone, and cartilage (connective tissue)
- Compact (KOM-pakt) Having a dense structure
- Degenerative (de-GEN-er-uh-tiv) Having progressively less function
- Extremities (ek-STERE-ee-tees) Arms or legs
- Ligament (LIG-uh-ment) Band of fibrous tissue that connects bones and supports joints
- Marrow (MAR-ow) Soft organic material filling the cavities of bones
- Orthopedic (or-thuh-PEE-dik) Pertaining to the correction of deformities
- Periosteum (par-ee-OST-ee-um) Specialized connective tissue covering all the bones of the body
- Resorption (re-SORP-shun) Loss of bone tissue caused by the action of specialized cells (osteoclasts)
- Synovial (SY-nov-ee-uhl) Pertaining to transparent alkaline fluid contained in joints
- Tendon (TEN-dun) Fibrous cord by which a muscle is attached to a bone