

- ◆ **Pharyngeal tonsils:** (also called *adenoids*) located in the nasopharynx (the upper part of the throat)
- ◆ **Lingual tonsils:** located on the back of the tongue

The **spleen** is an organ located beneath the left side of the diaphragm and in back of the upper part of the stomach. It produces leukocytes and antibodies, destroys old erythrocytes (red blood cells), stores erythrocytes to release into the bloodstream if excessive bleeding occurs, destroys thrombocytes (platelets), and filters metabolites and wastes from body tissues.

The **thymus** is a mass of lymph tissue located in the center of the upper chest. It atrophies (wastes away) after puberty and is replaced by fat and connective tissue. During early life, it produces antibodies and manufactures lymphocytes to fight infection. Its function is taken over by the lymph nodes.

## DISEASES AND ABNORMAL CONDITIONS

### Adenitis

Adenitis is an inflammation or infection of the lymph nodes. It occurs when large quantities of harmful substances, such as pathogens or cancer cells, enter the lymph nodes and infect the tissue. Symptoms include fever and swollen, painful nodes. If the infection is not treated, an abscess may form in the node. Usually treatment methods are antibiotics and warm, moist compresses. If an abscess forms, it is sometimes necessary to incise and drain the node.

### Hodgkin's Disease

Hodgkin's disease is a chronic, malignant disease of the lymph nodes. It is the most common form of lymphoma (tumor of lymph tissue). Symptoms include painless swelling of the lymph nodes, fever, night sweats, weight loss, fatigue, and pruritus (itching). Chemotherapy and radiation are usually effective forms of treatment.

ritus (itching). Chemotherapy and radiation are usually effective forms of treatment.

### Lymphangitis

Lymphangitis is an inflammation of lymphatic vessels, usually resulting from an infection in an extremity. Symptoms include a characteristic red streak extending up an arm or leg from the source of infection, fever, chills, and tenderness or pain. Treatment methods include antibiotics, rest, elevation of the affected part, and/or warm, moist compresses.

### Splenomegaly

Splenomegaly is an enlargement of the spleen. It can result from an abnormal accumulation of red blood cells, mononucleosis, and cirrhosis of the liver. The main symptoms are swelling and abdominal pain. An increased destruction of blood cells can lead to anemia (low red blood cell count), leukopenia (low white blood cell count), and thrombocytopenia (low thrombocyte count). If the spleen ruptures, intraperitoneal hemorrhage and shock can lead to death. In severe cases, where the underlying cause cannot be treated, a splenectomy (surgical removal of the spleen) is performed.

### Tonsillitis

Tonsillitis is an inflammation or infection of the tonsils. It usually involves the pharyngeal (adenoid) and palatine tonsils. Symptoms include throat pain, dysphagia (difficulty swallowing), fever, white or yellow spots of exudate on the tonsils, and swollen lymph nodes near the mandible. Antibiotics, warm throat irrigations, rest, and analgesics for pain are the main forms of treatment. Chronic, frequent infections or hypertrophy (enlargement) that causes obstruction are indications for a tonsillectomy, or surgical removal of the tonsils.

**STUDENT:** Go to the workbook and complete the assignment sheet for 7:9, Lymphatic System.

## 7:10 Respiratory System

### Objectives

After completing this section, you should be able to:

- ◆ Label a diagram of the respiratory system
- ◆ List five functions of the nasal cavity
- ◆ Identify the three sections of the pharynx
- ◆ Explain how the larynx helps create sound and speech

### KEY TERMS

**alveoli** (ahl-vee'-oh''-lie)

**bronchi** (bron'-kie)

**bronchioles** (bron'-key''-ohlz)

**cellular respiration**

**cilia** (sil'-lee-ah)

**epiglottis** (ep-ih-glott'-tiss)

**expiration**

**external respiration**

**inspiration**

**internal respiration**

**larynx** (lar'-inks)

**lungs**

**nasal cavities**

**nasal septum**

**nose**

**pharynx** (far'-inks)

**pleura**

**respiration**

**respiratory system** (res'-peh-reh-tor'-ee)

**sinuses**

**trachea** (tray'-key''-ah)

**ventilation**

### RELATED HEALTH CAREERS

◆ Internist

◆ Otolaryngologist

◆ Perfusionist

◆ Pulmonologist

◆ Respiratory Therapist

◆ Respiratory Therapy Technician

◆ Thoracic Surgeon

### 7:10 INFORMATION

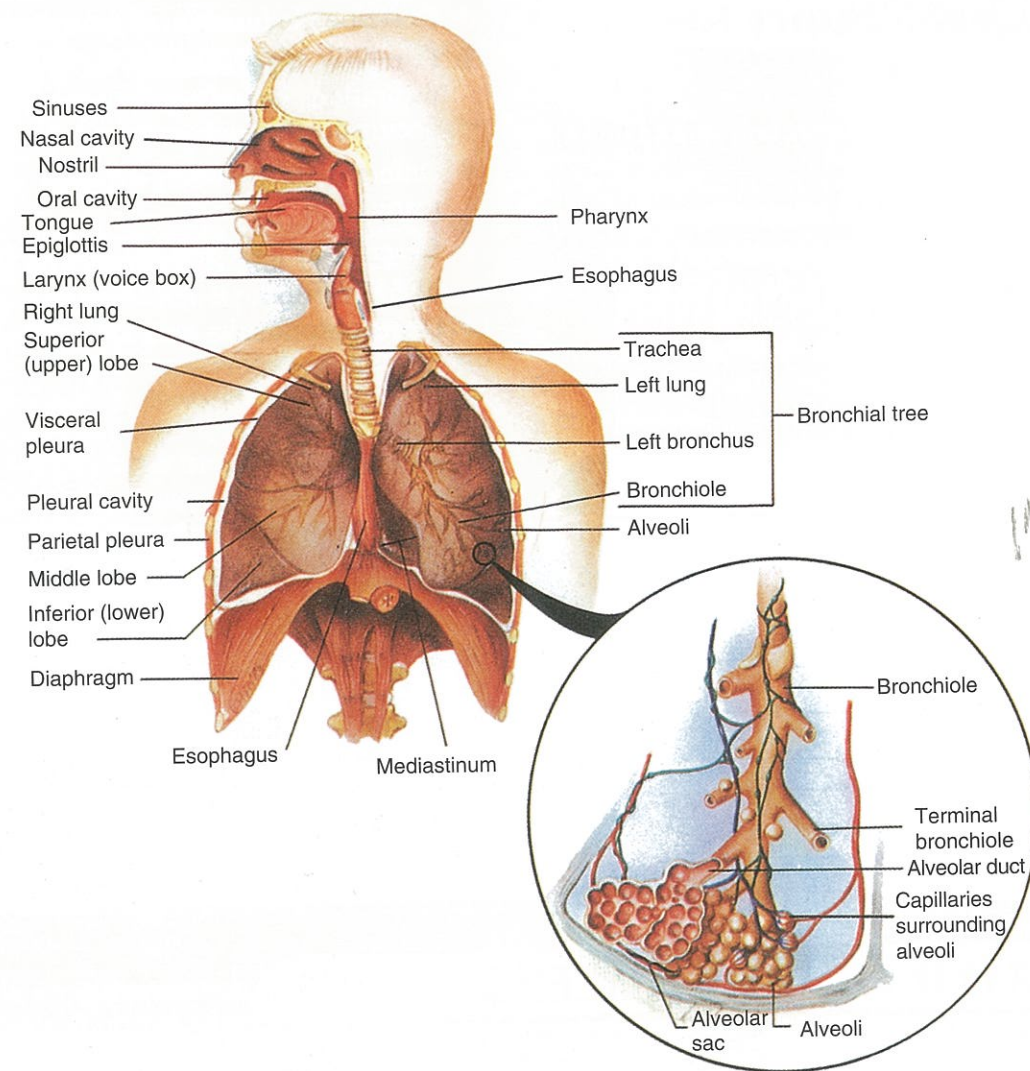
The **respiratory system** consists of the lungs and air passages. This system is responsible for taking in oxygen, a gas needed by all body cells, and removing carbon dioxide, a gas that is a metabolic waste product produced by the cells when the cells convert food into energy. Because the body has only a 4–6-minute supply of oxygen, the respiratory system must work continuously to prevent death.

The parts of the respiratory system are the nose, pharynx, larynx, trachea, bronchi, alveoli, and lungs (figure 7-52).

### RESPIRATORY ORGANS AND STRUCTURES

The **nose** has two openings, called *nostrils* or *nares*, through which air enters. A wall of cartilage, called the **nasal septum**, divides the nose into two hollow spaces, called **nasal cavities**. The nasal cavities are lined with a mucous membrane and have a rich blood supply. As air enters the cavities, it is warmed, filtered, and moistened. Mucus, produced by the mucous membranes, moistens the air and helps trap pathogens and dirt. Tiny, hairlike structures, called **cilia**, filter





**FIGURE 7-52** The respiratory system.

inhaled air to trap dust and other particles. The cilia then help move the mucous layer that lines the airways to push trapped particles toward the esophagus, where they can be swallowed. The *olfactory receptors* for the sense of smell are also located in the nose. The *nasolacrimal ducts* drain tears from the eye into the nose to provide additional moisture for the air.

**Sinuses** are cavities in the skull that surround the nasal area. They are connected to the nasal cavity by short ducts. The sinuses are lined with a mucous membrane that warms and moistens air. The sinuses also provide resonance for the voice.

The **pharynx**, or throat, lies directly behind the nasal cavities. As air leaves the nose, it enters the pharynx. The pharynx is divided into three

sections. The *nasopharynx* is the upper portion, located behind the nasal cavities. The pharyngeal tonsils, or adenoids (lymphatic tissue), and the eustachian tube (tube to middle ear) openings are located in this section. The *oropharynx* is the middle section, located behind the oral cavity (mouth). This section receives both air from the nasopharynx and food and air from the mouth. The *laryngopharynx* is the bottom section of the pharynx. The esophagus, which carries food to the stomach, and the trachea, which carries air to and from the lungs, branch off the laryngopharynx.

The **larynx**, or voice box, lies between the pharynx and trachea. It has nine layers of cartilage. The largest, the thyroid cartilage, is commonly called the *Adam's apple*. The larynx

contains two folds, called *vocal cords*. The opening between the vocal cords is called the *glottis*. As air leaves the lungs, the vocal cords vibrate and produce sound. The tongue and lips act on the sound to produce speech. The **epiglottis**, a special leaflike piece of cartilage, closes the opening into the larynx during swallowing. This prevents food and liquids from entering the respiratory tract.

The **trachea** (windpipe) is a tube extending from the larynx to the center of the chest. It carries air between the pharynx and the bronchi. A series of C-shaped cartilages (which are open on the dorsal, or back, surfaces) help keep the trachea open.

The trachea divides into two **bronchi** near the center of the chest, a right bronchus and a left bronchus. The right bronchus is shorter, wider, and extends more vertically than the left bronchus. Each bronchus enters a lung and carries air from the trachea to the lung. In the lungs, the bronchi continue to divide into smaller and smaller bronchi until, finally, they divide into the smallest branches, called **bronchioles**. The smallest bronchioles, called *terminal bronchioles*, end in air sacs, called *alveoli*.

The **alveoli** resemble a bunch of grapes. An adult lung contains approximately 500 million alveoli. They are made of one layer of squamous epithelial tissue and contain a rich network of blood capillaries. The capillaries allow oxygen and carbon dioxide to be exchanged between the blood and the lungs. The inner surfaces of the alveoli are covered with a lipid (fatty) substance, called *surfactant*, to help prevent them from collapsing.

The divisions of the bronchi and the alveoli are found in organs called **lungs**. The right lung has three sections, or lobes: the superior, the middle, and the inferior. The left lung has only two lobes: the superior and the inferior. The left lung is smaller because the heart is located toward the left side of the chest. Each lung is enclosed in a membrane, or sac, called the **pleura**. The pleura consists of two layers of serous membrane: a visceral pleura attached to the surface of the lung, and a parietal pleura attached to the chest wall. A pleural space, located between the two layers, is filled with a thin layer of pleural fluid that lubricates the membranes and prevents friction as the lungs expand during breathing. Both of the lungs, along with the heart and major blood vessels, are located in the thoracic cavity.

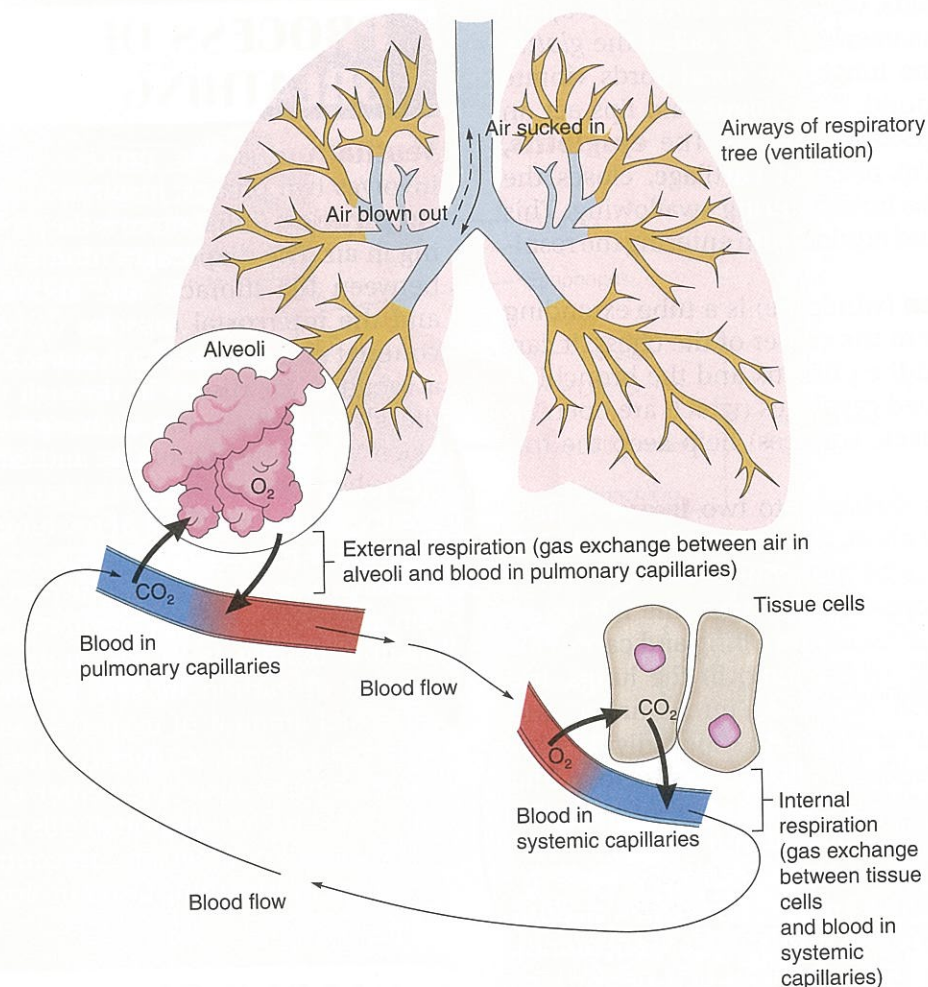
## PROCESS OF BREATHING

**Ventilation** is the process of breathing. It involves two phases: inspiration and expiration. **Inspiration** (inhalation) is the process of breathing in air. The diaphragm (dome-shaped muscle between the thoracic and abdominal cavities) and the intercostal muscles (between the ribs) contract and enlarge the thoracic cavity to create a vacuum. Air rushes in through the airways to the alveoli, where the exchange of gases takes place. When the diaphragm and intercostal muscles relax, the process of **expiration** (exhalation) occurs. Air is forced out of the lungs and air passages. This process of inspiration and expiration is known as **respiration**. The process of respiration is controlled by the respiratory center in the medulla oblongata of the brain. An increased amount of carbon dioxide in the blood, or a decreased amount of oxygen as seen in certain diseases (asthma, congestive heart failure, or emphysema), causes the center to increase the rate of respiration. Although this process is usually involuntary, a person can control the rate of breathing by breathing faster or slower.

## STAGES OF RESPIRATION

There are two main stages of respiration: external respiration and internal respiration (figure 7-53). **External respiration** is the exchange of oxygen and carbon dioxide between the lungs and bloodstream. Oxygen, breathed in through the respiratory system, enters the alveoli. Because the oxygen concentration in the alveoli is higher than the oxygen concentration in the blood capillaries, oxygen leaves the alveoli and enters the capillaries and the bloodstream. Carbon dioxide, a metabolic waste product, is carried in the bloodstream. Because the carbon dioxide concentration in the capillaries is higher than the carbon dioxide concentration in the alveoli, carbon dioxide leaves the capillaries and enters the alveoli, where it is expelled from the body during exhalation. **Internal respiration** is the exchange of carbon dioxide and oxygen between the tissue cells and the bloodstream. Oxygen is carried to the tissue cells by the blood. Because the oxygen





**FIGURE 7-53** External and internal respiration.

concentration is higher in the blood than in the tissue cells, oxygen leaves the blood capillaries and enters the tissue cells. The cells then use the oxygen and nutrients to produce energy, water, and carbon dioxide. This process is called **cellular respiration**. Because the carbon dioxide concentration is higher in tissue cells than in the bloodstream, carbon dioxide leaves the cells and enters the bloodstream to be transported back to the lungs, where external respiration takes place.

## DISEASES AND ABNORMAL CONDITIONS

### Asthma

Asthma is a respiratory disorder usually caused by a sensitivity to an allergen such as dust, pollen, an animal, medications, or a food. Stress, overex-

ertion, and infection can also cause an asthma attack, during which bronchospasms narrow the openings of the bronchioles, mucus production increases, and edema develops in the mucosal lining. Symptoms of an asthma attack include dyspnea (difficult breathing), wheezing, coughing accompanied by expectoration of sputum, and tightness in the chest. Treatment methods include bronchodilators (to enlarge the bronchioles), anti-inflammatory medications, epinephrine, and oxygen therapy. Identification and elimination of or desensitization to allergens are important in preventing asthma attacks.

### Bronchitis

Bronchitis is an inflammation of the bronchi and bronchial tubes. *Acute bronchitis* is usually caused by infection and is characterized by a productive cough, dyspnea, rales (bubbly or noisy breath

sounds), chest pain, and fever. It is treated with antibiotics, expectorants (to remove excessive mucus), rest, and drinking large amounts of water. *Chronic bronchitis* results from frequent attacks of acute bronchitis and long-term exposure to pollutants or smoking. It is characterized by chronic inflammation, damaged cilia, and enlarged mucous glands. Symptoms include excessive mucus resulting in a productive cough, wheezing, dyspnea, chest pain, and prolonged air expiration. Although there is no cure, antibiotics, bronchodilators, and/or respiratory therapy are used in treatment.

## Chronic Obstructive Pulmonary Disease

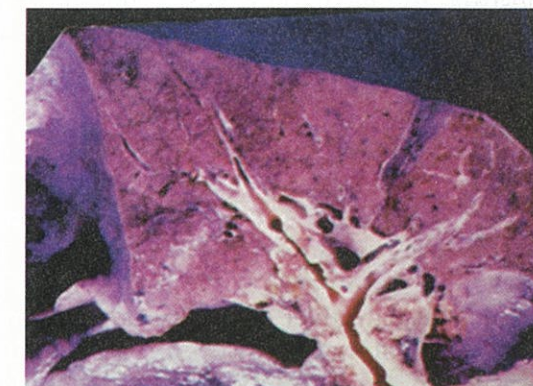
Chronic obstructive pulmonary disease (COPD) is a term used to describe any chronic lung disease that results in obstruction of the airways. Disorders such as chronic asthma, chronic bronchitis, emphysema, and tuberculosis lead to COPD. Smoking is the primary cause, but allergies and chronic respiratory infections are also factors. Treatment methods include bronchodilators, mucolytics (loosen mucus secretions), and cough medications. The prognosis is poor because damage to the lungs causes a deterioration of pulmonary function, leading to respiratory failure and death.

### Emphysema

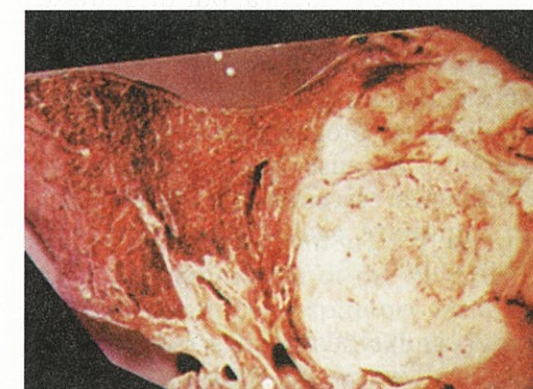
Emphysema is a noninfectious, chronic respiratory condition that occurs when the walls of the alveoli deteriorate and lose their elasticity (figure 7-54). Carbon dioxide remains trapped in the alveoli, and there is poor exchange of gases. The most common causes are heavy smoking and prolonged exposure to air pollutants. Symptoms include dyspnea, a feeling of suffocation, pain, barrel chest, chronic cough, cyanosis, rapid respirations accompanied by prolonged expirations, and eventual respiratory failure and death. Although there is no cure, treatment methods include bronchodilators, breathing exercises, prompt treatment of respiratory infections, oxygen therapy, respiratory therapy, and avoidance of smoking.

### Epistaxis

Epistaxis, or a nosebleed, occurs when capillaries in the nose become congested and bleed. It can be caused by an injury or blow to the nose, hyper-



Normal lung



Cancer



Emphysema

**FIGURE 7-54** Two common lung diseases are emphysema and cancer. (Reprinted by the permission of the American Cancer Society, Inc. All rights reserved.)

tension, chronic infection, anticoagulant drugs, and blood diseases such as hemophilia and leukemia. Compressing the nostrils toward the septum; elevating the head and tilting it slightly forward; and applying cold compresses will usually control epistaxis, although it is sometimes necessary to insert nasal packs or cauterize (burn



and destroy) the bleeding vessels. Treatment of any underlying cause, such as hypertension, is important in preventing epistaxis.

## Influenza

Influenza, or flu, is a highly contagious viral infection of the upper respiratory system. Onset is sudden, and symptoms include chills, fever, a cough, sore throat, runny nose, muscle pain, and fatigue. Treatment methods include bed rest, fluids, analgesics (for pain), and antipyretics (for fever). Antibiotics are not effective against the viruses that cause influenza, but they are sometimes given to prevent secondary infections such as pneumonia. Immunization with a flu vaccine is recommended for the elderly, individuals with chronic diseases, pregnant women, and health care workers. Because many different viruses cause influenza, vaccines are developed each year to immunize against the most common viruses identified.

## Laryngitis

Laryngitis is an inflammation of the larynx and vocal cords. It frequently occurs in conjunction with other respiratory infections. Symptoms include hoarseness or loss of voice, sore throat, and dysphagia (difficult swallowing). Treatment methods include rest, limited voice use, fluids, and medication, if an infection is present.

## Lung Cancer

Lung cancer is the leading cause of cancer death in both men and women (figure 7-54). It is a preventable disease because the main cause is exposure to carcinogens in tobacco, either through smoking or through exposure to “second-hand” smoke. Three common types of lung cancer include small cell, squamous cell, and adenocarcinoma. In the early stages, there are no symptoms. In later stages, symptoms include a chronic cough, hemoptysis (coughing up blood-tinged sputum), dyspnea, fatigue, weight loss, and chest pain. The prognosis (outcome) for lung cancer patients is poor because the disease is usually advanced before it is diagnosed. Treatment includes surgical removal of the cancerous sections of the lung, radiation, and/or chemotherapy.

## Pleurisy

Pleurisy is an inflammation of the pleura, or membranes, of the lungs. It usually occurs in conjunction with pneumonia or other lung infections. Symptoms include sharp, stabbing pain while breathing; crepitation (grating sounds in the lungs); dyspnea; and fever. Treatment methods include rest and medications to relieve pain and inflammation. If fluid collects in the pleural space, a *thoracentesis* (withdrawal of fluid through a needle) is performed to remove the fluid and prevent compression of the lungs.

## Pneumonia

Pneumonia is an inflammation or infection of the lungs characterized by exudate (a buildup of fluid) in the alveoli. It is usually caused by bacteria, viruses, protozoa, or chemicals. Symptoms include chills, fever, chest pain, productive cough, dyspnea, and fatigue. Treatment methods include bed rest, oxygen therapy, fluids, antibiotics (if indicated), respiratory therapy, and/or pain medication.

## Rhinitis

Rhinitis is an inflammation of the nasal mucous membrane, resulting in a runny nose, watery eyes, sneezing, soreness, and congestion. Common causes are infections and allergens. Treatment consists of administering fluids and medications to relieve congestion. Rhinitis is usually self-limiting.

## Sinusitis

Sinusitis is an inflammation of the mucous membrane lining the sinuses. One or more sinuses may be affected. Sinusitis is usually caused by a bacterium or virus. Symptoms include headache or pressure, dizziness, thick nasal discharge, congestion, and loss of voice resonance. Treatment methods include analgesics (for pain), antibiotics (if indicated), decongestants (medications to loosen secretions), and moist inhalations. Surgery is used in cases of chronic sinusitis to open the cavities and encourage drainage.

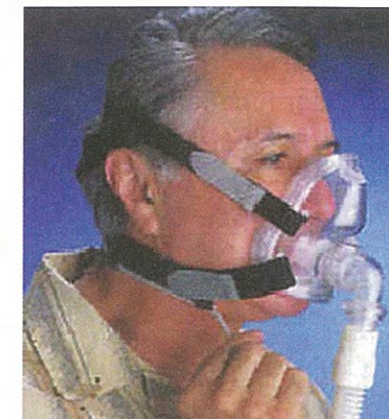
## Sleep Apnea

Sleep apnea is a condition in which an individual stops breathing while asleep, causing a measurable decrease in blood oxygen levels. There

are two main kinds of sleep apnea: obstructive and central. *Obstructive sleep apnea* is caused by a blockage in the air passage that occurs when the muscles that keep the airway open relax and allow the tongue and palate to block the airway. *Central sleep apnea* is caused by a disorder in the respiratory control center of the brain. The condition is more common in men. Factors such as obesity, hypertension, smoking, alcohol ingestion, and/or the use of sedatives may increase the severity. Sleep apnea is diagnosed when more than 5 periods of apnea lasting at least 10 seconds each occur during 1 hour of sleep. The periods of apnea reduce the blood oxygen level. This causes the brain to awaken the individual, who then gasps for air and snores loudly. This interruption of the sleep cycle leads to excessive tiredness and drowsiness during the day. Treatment involves losing weight, abstaining from smoking and the use of alcohol or sedatives, and sleeping on the side or stomach. In more severe cases of obstructive sleep apnea, a continuous positive airway pressure, or CPAP (pronounced see-pap), is used to deliver pressure to the airway to keep the airway open while the individual sleeps (figure 7-55). The CPAP consists of a mask that is fit securely against the face. Tubing connects the mask with a blower device that can be adjusted to deliver air at different levels of pressure. Treatment of central sleep apnea usually involves the use of medications to stimulate breathing.

## Tuberculosis

Tuberculosis (TB) is an infectious lung disease caused by the bacterium *Mycobacterium tuberculosis*. At times, white blood cells surround the invading TB organisms and wall them off, creating nodules, called *tubercles*, in the lungs. The TB organisms remain dormant in the tubercles but can cause an active case of TB later, if body resistance is lowered. Symptoms of an active case of TB include fatigue, fever, night sweats, weight loss, hemoptysis (coughing up blood-tinged sputum), and chest pain. Treatment includes administering drugs for one or more years to destroy the bacteria. Good nutrition and rest are also important. In recent years, a new strain of the TB bacteria resistant to drug therapy has created concern that TB will become a widespread infectious disease.



**FIGURE 7-55** The continuous positive airway pressure (CPAP) mask attaches to a blower device that uses air pressure to keep the airway open and prevent sleep apnea.

## Upper Respiratory Infection

An upper respiratory infection (URI), or common cold, is an inflammation of the mucous membrane lining the upper respiratory tract. Caused by viruses, URIs are highly contagious. Symptoms include fever, runny nose, watery eyes, congestion, sore throat, and hacking cough. There is no cure, and symptoms usually last approximately one week. Analgesics (for pain), antipyretics (for fever), rest, increased fluid intake, and antihistamines (to relieve congestion) are used to treat the symptoms.

**STUDENT:** Go to the workbook and complete the assignment sheet for 7:10, Respiratory System.

## 7:11 Digestive System

### Objectives

After completing this section, you should be able to:

- ◆ Label the major organs on a diagram of the digestive system
- ◆ Identify at least three organs that are located in the mouth and aid in the initial breakdown of food
- ◆ Cite two functions of the salivary glands
- ◆ Describe how the gastric juices act on food in the stomach
- ◆ Explain how food is absorbed into the body by the villi in the small intestine