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.

6. Use the internet to investigate cystic fibrosis or another respiratory disorder. Create a poster that describes the condition including the cause, treatment, and outlook.

**Explore the Web**

**Cystic Fibrosis**
Cystic Fibrosis Foundation
http://www.cff.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) Saclike cavity filled with fluid to prevent friction

Cancellous (KAN-seh-lus) Spongy or latticelike structure

Cartilage (KAR-thil-ij) 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-ar uh-tiv) Having progressively less function

Extremities (ek-STREM-ih-teess) Arms or legs

Ligament (LIG-uh-ment) Band of fibrous tissue that connects bones and supports joints

Marrow (MARE-oh) Soft organic material filling the cavities of bones

Orthopedic (or-tho-PED-ik) Pertaining to the correction of deformities

Periosteum (per-ee-oh-SOE-tum) 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 (sin-oh-vi-ahl) Pertaining to transparent alkaline fluid contained in joints

Tendon (TEN-dun) Fibrous cord by which a muscle is attached to a bone
Skeletal System Terminology

Osteoarthritis may cause Heberden's nodes to form around the knuckles. (From Kramir A, Broedel M, eds. A color atlas of medicinal medicine, ed 2, St. Louis, 1991, Mosby.)

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
<th>Prefix</th>
<th>Root</th>
<th>Suffix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arthritis</td>
<td>Inflammation of the joint</td>
<td>arthr</td>
<td>its</td>
<td></td>
</tr>
<tr>
<td>Arthrodesis</td>
<td>Surgical union or fixation of the joint</td>
<td>arthr/o</td>
<td>desis</td>
<td></td>
</tr>
<tr>
<td>Arthroplasty</td>
<td>Plastic reconstruction of the joint</td>
<td>arthr/o</td>
<td>plasty</td>
<td></td>
</tr>
<tr>
<td>Cervical</td>
<td>Pertaining to the neck</td>
<td>cervic</td>
<td>al</td>
<td></td>
</tr>
<tr>
<td>Chondrectomy</td>
<td>Removal of the cartilage</td>
<td>chondr</td>
<td>ectomy</td>
<td></td>
</tr>
<tr>
<td>Intercoastal</td>
<td>Between the ribs</td>
<td>inter</td>
<td>coast</td>
<td>al</td>
</tr>
<tr>
<td>Odontology</td>
<td>Study of the tooth</td>
<td>odont</td>
<td>ology</td>
<td></td>
</tr>
<tr>
<td>Orthopedics</td>
<td>Pertaining to correcting or straightening the bones</td>
<td>ortho</td>
<td>ped</td>
<td>ics</td>
</tr>
<tr>
<td>Osteoarthritis</td>
<td>Inflammation of the bones and joints</td>
<td>osteo</td>
<td>arthr</td>
<td>risis</td>
</tr>
<tr>
<td>Periodontal</td>
<td>Around the tooth</td>
<td>peri/o</td>
<td>dont</td>
<td>al</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 Skeletal System

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>AKA</td>
<td>Above knee amputation</td>
</tr>
<tr>
<td>Amb</td>
<td>Ambulatory</td>
</tr>
<tr>
<td>Bil</td>
<td>Bilateral</td>
</tr>
<tr>
<td>CAT</td>
<td>Computed axial tomography</td>
</tr>
<tr>
<td>CXR</td>
<td>Chest x-ray</td>
</tr>
<tr>
<td>Ext</td>
<td>Extremity</td>
</tr>
<tr>
<td>Fx</td>
<td>Fracture</td>
</tr>
<tr>
<td>Lat</td>
<td>Lateral</td>
</tr>
<tr>
<td>Lz</td>
<td>Left</td>
</tr>
<tr>
<td>Ortho</td>
<td>Orthopedics</td>
</tr>
</tbody>
</table>

Structure and Function of the Skeletal System

The human body has more than 200 bones (Table 14-1). The skeletal system works directly with the muscular system to perform many functions, including the following:

- Providing shape and support
- Protecting internal organs
- Storing minerals and fat
- Producing blood cells and platelets
- Assisting in movement

Bone tissue is composed of inorganic salts (particularly calcium phosphate), water, and organic material such as bone cells, blood vessels, nerves, and elastic material (collagen). Like other body cells, bone cells must continuously receive food and oxygen. However, bones and their adjoining structures, ligaments, and tendons have fewer nerves and blood vessels than other body structures.

Bones continue to grow for the first 18 to 20 years of life. Even after growth stops, bone cells die and are replaced by new cells throughout life. Osteoclasts are cells in the bone tissue that produce new cells. Osteoclasts are cells that break down bone cells (resorption).

Types of Bones

The skeletal system consists of two major groups of bones (Fig. 14-1):

- The axial skeleton includes the 80 bones of the head and trunk.
- The appendicular skeleton includes the 126 bones of the pelvis, shoulders, arms, and legs (extremities).

Bones are also classified by shape (Table 14-2):

- Long bones are longer than they are wide.

**TABLE 14-1**

<table>
<thead>
<tr>
<th>Part of the Body</th>
<th>Body Part</th>
<th>Body Part Division</th>
<th>Names of Bones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axial skeleton</td>
<td>Skull</td>
<td>(28)</td>
<td>Cranium (8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Face (14)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hyoid (1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spinal column (26)</td>
<td></td>
</tr>
<tr>
<td>Appendicular</td>
<td>Sternum</td>
<td>(23)</td>
<td>Cervical vertebral (7), thoracic vertebrae (12), lumbar vertebrae (5), sacrum (1), coccyx (1)</td>
</tr>
<tr>
<td>skeletal</td>
<td>and ribs</td>
<td>Upper extremities (64)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lower extremities (62)</td>
<td></td>
</tr>
</tbody>
</table>

Bones may have cartilage, a fibrous connective tissue, on some surfaces to prevent friction. Bones are attached to other bones by ligaments. A sheet of fibrous tissue connecting bone to bone is called an aponeurosis (ap-oo-NOH-sis). Bones are joined to muscles by tendons. Fascia (FASH-ee-uh) is a variable fibrous connective tissue that joins organs. Chapter 15 provides more information about the muscular system. The two major types of bone tissue are dense (compact) and loosely packed or spongy (cancellous).

**BRAIN BYTE**

When a person is born, the body has more than 300 separate bones. After some fuse, there are only 206.

**Skull**

The skull includes the bones of the cranium, face, and ear. The cranium is made up of eight bones (Fig. 14-2). The sinuses cavities make the skull lighter and the voice sound stronger. At birth, the bones of the cranium have two openings called fontanelles. These close by 2 years of age. The face is made up of 13 bones (Fig. 14-3). The lower jaw (mandible) is the only movable bone of the skull.

**Teeth**

The adult has 32 teeth after the deciduous or primary teeth are replaced (Fig. 14-4). Each tooth has a number of parts (Fig. 14-5):

- The crown is the white section above the gum.
- The root is below the gum.
the sternum. The lower five pairs of ribs are called "false" ribs and are not attached directly to the sternum. The costal cartilage of each false rib attaches it to the rib above it. The bottom two pairs of false ribs are attached only to the spine and are called "floating" ribs. The area between the ribs is called intercostal space. It contains muscles, blood vessels, and nerves.

**Vertebral Column**

The adult vertebral (spinal) column consists of 26 vertebrae and has five parts (Fig. 14-7). The curvature of the vertebral column gives it strength and flexibility. Between the vertebrae are disks of cartilage that cushion the bones and allow movement.

**Long Bones of the Extremities**

The long bones of the arms and legs contain marrow that makes blood cells for the body. Long bones grow and lengthen from a layer of cartilage called the epiphyseal plate. This area becomes completely ossified when the bones stop growing. The different parts of the long bone are shown in Fig. 14-8.

The diaphysis, or shaft, of the long bone contains fatty tissue and yellow marrow in its cavity. This fatty

---

**TABLE 14-2**

<table>
<thead>
<tr>
<th>Shape of Bone</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long</td>
<td>Femur, humerus, radius, ulna, tibia, fibula</td>
</tr>
<tr>
<td>Short</td>
<td>Tarsal, carpal, metatarsal, metacarpal</td>
</tr>
<tr>
<td>Flat</td>
<td>Cranial, costal, scapula, sternum</td>
</tr>
<tr>
<td>Irregular</td>
<td>Vertebrae, mandible, ilium, ossicle, patella</td>
</tr>
</tbody>
</table>

- Enamel, the hardest substance in the body, covers the crown.
- Cementum is the hard, bone-like substance covering the root.
- Dentin is located between the enamel and the pulp.
- The pulp is the soft, living portion of the tooth, containing the nerves and blood vessels. The four major types of teeth have different shapes and functions (Table 14-3).

**Thorax**

The thorax is the part of the skeletal system that includes the ribs, sternum, and vertebral bones that protect the lungs and heart (Fig. 14-6). The first seven pairs of ribs are called "true" ribs and are attached to

**FIGURE 14-2** The bones of the skull include the cranium, face, and ears.

**FIGURE 14-3** The skeleton includes the bones of the face. (The palate [2] and inferior turbinate [2] are not visible.)

**FIGURE 14-4** Tooth development.
**TABLE 14-3**

<table>
<thead>
<tr>
<th>Tooth Type</th>
<th>Number</th>
<th>Function</th>
<th>Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incisor</td>
<td>8</td>
<td>Cuts food</td>
<td>Front of mouth</td>
<td>Broad, sharp edge</td>
</tr>
<tr>
<td>Cuspid (canines or eyeteeth)</td>
<td>4</td>
<td>Tears food</td>
<td>(central or lateral)</td>
<td>Longest in mouth</td>
</tr>
<tr>
<td>Bicuspid (granmolar)</td>
<td>8</td>
<td>Pulverizes or</td>
<td>Between cuspsids and</td>
<td>Flat</td>
</tr>
<tr>
<td>Molar</td>
<td>12*</td>
<td>Grinds food</td>
<td>molars</td>
<td>Largest, strongest</td>
</tr>
</tbody>
</table>

*The third molar is called the "wisdom" tooth. It does not appear in all individuals.*

---

**CASE STUDY 14-1**

Your friend tells you that he has grown 6 inches this year and cramping pains in his legs from growing are hurting him at night. What should you say?

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

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**Bone Markings**

Bone markings are the shapes of different parts of bones (Table 14-4). There are four major types of bone markings:

- Projections bulge from a bone and attach to muscles, ligaments, and tendons.
- Openings are holes or spaces in bones.
- Depressions include openings and cavities in bone.
- Ridges are lines on a bone surface.

---

**Joints**

Two or more bones join together at a joint, also called an articulation. Joints are commonly named by the bones that are joined. For example, the sternoclavicular joint is between the sternum and clavicle. The following list describes the three types of joints:

- Immovable (synarthrosis)
- Slightly movable (amphiarthrosis)
- Freely movable (diarthrosis)

An example of an immovable joint is any one of the sutures of the cranium after they have ossified and closed. An example of a slightly movable joint is a pelvic bone.

Movable joints are also called synovial joints. They contain a protective bursa, which is a sac filled with synovial fluid that cushions the moving parts. Bursae are found at the freely movable joints such as the elbows, knees, hips, shoulders, and ankles. The six types of diarthroses joints are named according to how they move (Fig. 14-9):

- Ball and socket joints of the shoulders and hips
- Hinge joints of the elbow and knee
- Gliding joints of the wrists
- Pivot joint at the base of the skull
- Saddle joint of the thumb
- Comphosis, such as the attachment of a tooth into its socket in the jaw

---

**Assessment Techniques**

Radiographic images (commonly referred to as x-rays) use electromagnetic energy that is absorbed by the body's tissues to produce images on photographic film. X-ray machines may be portable or stationary. They may be used to detect bone fractures, cancer, infection, arthritis, and deformities (Fig. 14-10). They may also be used to determine bone age, congenital skull deformities, and injuries resulting from abuse in children. Although having an x-ray taken has minimal risk and is painless, it is less sensitive than a bone scan in detecting bone destruction.

Bone marrow aspiration or sampling is accomplished by inserting a long needle into the spinal column to remove marrow. The sample is used to determine the cause of an abnormal blood test or unexplained blood disorders such as leukemia, sample for pathogens or chromosome abnormalities, and evaluate a response to cancer treatment. It may be performed in the hospital or as an outpatient procedure.
Although the procedure has relatively few complications, it may cause discomfort.

A bone marrow biopsy is used to obtain a piece of bone containing intact marrow to identify abnormalities such as thrombocythemia. It is also used to diagnose tumors, lymphoma, and the cause of an unexplained fever. It may also be used if bone marrow aspiration is unsuccessful. The procedure is similar to the bone marrow aspiration except that a core of bone is removed for examination.

A radionuclide bone scan or bone scintigraphy is used to detect bone cancer when x-rays do not show any abnormalities but a malignancy is suspected. It may also be used to locate a bone infection and other abnormalities. Stress fractures that do not show on x-rays may be seen by using a bone scan. The procedure involves injection of the radionuclide, which spreads through the bone. Increased concentration of the material indicates a diseased area.

A computed tomography (CT) scanner is a machine that sends several beams of x-rays simultaneously from different angles. A computer determines the relative density of the tissues examined by the strength of the beams. The technique of CT scanning was developed by Sir Geoffrey Hounsfield, who was awarded the Nobel Prize for his work. The CT scanner is used for taking pictures of every part of the body.

Magnetic resonance imaging (MRI) uses magnetic and radio waves to show computerized images of the body. No exposure to x-rays or any other damaging forms of radiation occurs with an MRI. Because the MRI scan shows detailed pictures, it is the best technique to identify tumors (benign or malignant) in the brain. The MRI scan can also show the heart and blood vessels. It is also used to examine the joints,

| TABLE 14-4 |
|-------------------|-------------------|-------------------|
| **Bone Markings** | **Type of Marking** | **Description** | **Example** |
| | Process | Narrow ridge | Iliac crest |
| | Crest | Rounded process that articulates with another bone | Occipital condyle of skull |
| | Condyle | Small, rounded elevation that attaches muscles and ligaments | Proximal end of humerus |
| | Tubercle | Large, rounded elevation that attaches muscles and ligaments | Ischial tuberosity |
| | Tuberosity | Very large projection | Greater trochanter of femur |
| | Trochanter | Rounded projection from neck of bone, articulates with cavity | Head of humerus |
| | Head | | |
| | Depression | Chamber or cavity in bone | Frontal sinus of skull |
| | Sinus | Opening for nerves and blood vessels | Foramen magnum |
| | Foramen | Narrow slit, cleft, or groove | Inferior orbital fissure of the eye |
| | Fissure | Shallow concave depression on bone surface | Acetabular fossa |

**CASE STUDY 14-2** You have a friend who has been diagnosed with leukemia. He is afraid he is going to die from it. What should you say?

Answers to Case Studies are available on the Evolve website: http://evolve.elsevier.com/Gerdin
nerve of the wrist resulting from repetitive use or trauma. The person with carpal tunnel syndrome may feel numbness, burning, tingling, pain, and weakness in the hand. Treatment may include restoring the affected wrist, splitting, anti-inflammatory medication, or surgical correction.

*Degenerative (de-GEN-er-uh-tiv) joint disease*, also called osteoarthritis (os-tee-o-ar-THRIE-tis), is usually associated with aging, but the cause is unknown. It is the most common form of arthritis. The condition has gradual onset as the cartilage in the joint softens. The person feels pain after exercise and stiffness after inactivity. Treatment for osteoarthritis includes medication to ease the pain and reduce inflammation. In severe cases the joint may be surgically replaced.

A *dislocation* (dis-lo-KAY-shun) occurs when bones move out of their proper location, usually in the shoulder or hip. Dislocation is either congenital or the result of trauma. The person feels pain and loss of mobility. The bones may relocate by themselves or require surgery. Ligaments may be damaged with dislocation injuries.

A *fracture* (FRAK-chur) is a broken bone caused by trauma. A fracture may be open (the skin is broken) or closed (skin is not broken). Swelling, bruising, and pain may occur. Treatment includes use of casts, traction, and electrical stimulation or ultrasound to increase the rate of healing.

*Gout* is painful swelling of a joint that results from the buildup of uric acid crystals, most commonly in the great toe. Fever and chills may also occur. The condition is usually due to an inability to adequately remove uric acid from the blood. Signs and symptoms of gout can result as a complication of another disorder. Treatment includes the use of medications, weight loss, and diet therapy that restricts the intake of purine.

A *herniated* (HER-ne-ay-ted) disk is a ruptured or "slipped" disk between vertebrae. It results in pain and reduced mobility. Treatment includes pain medication, bed rest, and possibly surgical correction.

*Kyphosis* (ki-POH-sis), also called "hunchback" or "humpback," is an abnormal curvature of the thoracic part of the spine (Fig. 14-14). The person with kyphosis may feel pain caused by affected nerves. The cause may be congenital or the effect of rheumatic arthritis, tumors, poor posture, or chronic respiratory diseases. Osteoporosis is the most common cause of kyphosis in adults. Treatment may include exercise to strengthen the back and bracing.

*Lordosis* (loor-DOE-sis), also called "swayback," is an abnormal curvature of the lumbar spine (see...
CAUSES

Heredity

Inactivity

Hormones

Aging

Bone loss

Normal level

FRACTURES

Spine (loss of height; thoracic kyphosis)

Deltoid radius

Proximal femur

Lordosis

Kyphosis

Scoliosis

FIGURE 14-11 Widow's hump" or "dowager's hump" and fractures may result from osteoporosis. (From Damjanov I: Pathology for the health professions, ed 3, St. Louis, 2006, Saunders.)

FIGURE 14-12 The hands may become deformed in rheumatoid arthritis as the joints soften. (From Stevens A, Lowe J: Pathology: Illustrated review in color, ed 2, London, 2000, Mosby.)

Fig. 14-14. The cause may be obesity, pregnancy, or poor posture. The person with lordosis may feel lower back pain. Treatment includes exercise and bracing.

Meningomyelocele (muh-ning-go-MIE-uh-lo-seel), also called spina bifida (SPY-nya BIF-ih-da), is a congenital condition of the spinal column. It can cause paralysis and nervous system disorders because of pressure on the spinal nerves. Most individuals with spina bifida do not have learning disabilities, although it may occur in some cases. Spina bifida is caused by genetic and environmental factors. Folic acid taken as a nutritional supplement before and during pregnancy reduces the risk of spina bifida.

Treatment includes surgery and the prevention of infection. Surgical correction of the opening has been done while the fetus is still in the uterus in some cases.

An osteoma (os-tee-O-ma) is a bone tumor. It may be noncancerous (benign) or cancerous (malignant). Its symptoms depend on the location and size of the growth. A benign growth can be cured by surgical removal. Some malignant bone tumors may require chemotherapy or surgical removal.

Osteosarcoma (os-tee-o-MAY-uh-sar-kah), also called rickets in children, is a softening of the bones caused by vitamin D and calcium deficiency. The person may experience pain, muscular weakness, anorexia, loss of weight, and deformity. Treatment includes adding nutrients to the diet.

Osteomyelitis (os-tee-o-may-uhl-LEE-tis) is a bacterial infection of bone. Sudden fever and pain may occur. The bacteria enter the bone via the bloodstream or from tissues around the bone that are infected. Treatment includes immobilization of the part and antibiotics.

FIGURE 14-13 External fixator. (From McCance KL, Huether SE: Pathophysiology: The biologic basis for disease in adults and children, ed 6, St. Louis, 2015, Mosby.)

FIGURE 14-15 Normal vertebral body (left) and osteoporotic specimen (right). (From Patton KT, Thibodeau GA: Anatomy & physiology, ed 7, St. Louis, 2010, Mosby.)

Osteoporosis (os-tee-o-po-RO-sis) is a weakening of the bones that affects more than 10 million people in the United States (Fig. 14-15). Another 34 million have osteopenia, or low bone mass, which may lead to osteoporosis. The bones become fragile and break usually in the hip, spine, and wrist. Women with small, thin builds are most likely to develop it, especially after menopause. Inadequate calcium in the diet, lack of exercise, and excessive use of caffeine and alcohol may also be associated with this condition. Lower back pain and abnormal curvature of the spine may result. No cure exists, but treatment to reduce symptoms includes dietary supplements of calcium and vitamin D. Estrogen and other hormone replacement therapies have been shown to improve bone density. In addition to pain medications and bracing, vertebroplasty may be used to control pain caused by compression fractures caused by osteoporosis. In this procedure, medical-grade cement is injected around the area of fracture to stabilize the bones. Kyphoplasty is a similar procedure but also expands the collapsed vertebra before injecting the cement. Bisphosphonates are a group of medications used to slow or repair the damage of osteoporosis.

CASE STUDY 14-3 Your friend tells you that her mother has shrunk more than 1 inch in height, and she thinks she is doing the same. What should you say?

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

Paget (PAJ-et) disease, also called osteitis deformans, is a condition of unknown cause. It usually appears
after the age of 35. Because of excessive destruction of bone cells, the long bones become bowed, and the flat bones are deformed. Although there may be no symptoms, bone pain, dizziness, headache, and deafness may result. Treatment, if necessary, includes medication, mild exercise, and a high-protein diet.

Periodontitis (pair-ee-o-don-tis) affects more than one in three people older than 30 years of age in the United States, according to the American Academy of Periodontology. It is the cause of most tooth loss in people older than the age of 35. Periodontitis is an inflammatory condition of the tissues that keeps teeth in place. It may start as sore, bleeding gums and may include persistent bad breath and tender, swollen, and reed- ing gums. In advanced stages, pus may form and teeth may loosen. Treatment may include removing the tooth, scraping the gums, and performing root canal surgery to remove the infected area.


**Issues and Innovations**

**Progress in Dental Care**

Dental health care includes more than repair of caries and treatment of periodontal disease. Dentistry now offers corrective measures for damaged, discolored, and misplaced teeth. Innovations include bonding, porcelain facing, bleaching, bracing, and tooth replacement. Bonding is a process to correct the surface of a tooth that is damaged or discolored. Bonding uses adhesive materials such as epoxy and ceramic powder. Porcelain veneers, another method of correcting surfaces, face composite resins. These last longer than bonding but are more costly. Seals or plastic coatings are used to fill spaces to prevent formation of caries.

New methods of bleaching are also used to remove stains from tooth surfaces. Gas plasma or blue light, pastes, and chemical strips are being used to whiten the surface of teeth. Exact coloration may be difficult with bleaching, and the process may weaken the tooth. Metal brackets, also called braces, traditionally worn by children, are now used by people of all ages. Other new methods to move teeth include plastic braces, which are less visible, and electrical stimulation.

Osteointegration is the process of placing implants into the bone to replace missing teeth. This process takes several months and more than one surgical treatment to place hardware made of inert substances such as titanium into the jaw bone (endosseous). Although there is a greater risk of infection than in other replacement techniques, the implants are more stable and last longer.

A chemical has been developed that softens areas of decay in a tooth. The decay dissolves and can be painlessly removed, reducing the need for traditional drilling of cavities. About 3000 dentists in the United States are now using this method. The chemical treatment usually costs more than drilling, and it takes longer to remove the decayed area, but this new chemical method may provide a better surface for bonding to the metals used for fillings. Dentists may also use air abrasion or lasers to remove dental caries. Amalgam fillings may be replaced by a composite material for patients who have a concern about the release of mercury into the body from fillings.

**Bone Substitutes and Repairs**

Several materials have been found to replace missing or damaged bones. One type of material, called endoapatite, consists of a mineral network that can mesh together with existing bone. This implant material has been shown to promote growth and repair of existing bone tissue.

Coral from the ocean has been used to repair bones by grafting (Fig. 14-16). This animal leaves a calcium deposit that is not rejected by the human body's immune system. Another advantage of using this material is its relative abundance. Coral is generally used for cranial grafts because it is not as rigid as bone or some other substitutes. Blocks of wood have been used as bone substitutes by researchers in Italy. In 2008, these researchers had implanted rattan wood as artificial bone in sheep. They estimate that human trials may start in 5 years.

![Figure 14-16: Coral has been used in grafting procedures to repair human bones.](image-url)
Functions of the skeletal system include protecting internal organs, storing minerals and fat, producing blood cells and platelets, and assisting in movement.

Structures of the skeletal system are divided into the axial and appendicular skeleton and include bones such as the cranium, humerus, femur, and ulna.

Methods of assessment of the skeletal system include x-rays, bone marrow aspiration, biopsy, CT, and MRI scans.

Disorders of the skeletal system include avulsions, fractures, caries, carpel tunnel syndrome, and kyphosis.

### Explore the Web

**Bone Health**
WebMD
http://www.webmd.com/ostoporosis/bone-mineral-density

National Institute of Arthritis and Musculoskeletal and Skin Disease (NIAMS)
http://www niams.nih.gov/Health_Info/Bone/Bone_Health/
Exercise/default.asp

**Bone Repair**
Medscape

Medline

**Dental Hygiene**
Academy of General Dentistry

American Dental Association (ADA)
http://www.ada.org/public/topics/whitening_faq.asp

## Summary

2. Investigate the function of at least five common medications used in treatment of skeletal system.
3. List at least five occupations involved in the health care of skeletal system disorders.
4. Use the Internet to investigate first-, second-, and third-class lever movement of joints.
5. Use the Internet to research the process and techniques used for bone repair after a fracture.
6. Use the Internet to make a poster or pamphlet showing the recommendations for healthy bones, including nutrition and exercise.
7. Use the Internet to investigate and make a poster or pamphlet that describes the methods for improving dental care and cosmetic appearance.

### Critical Thinking

1. Investigate and compare the cost of at least three tests used to diagnose disorders of the skeletal system.

### Review Questions

1. Describe the five functions of the skeletal system.
2. In one or more sentences, identify the location of each of the following bones of the skeletal system and the characteristics these bones have in common: femur, fibula, humerus, radius,ibia, and ulna.
3. Identify a disorder of the skeletal system that has similar effects as kyphosis.
4. Describe the functions of red and yellow bone marrow.
5. Describe six types of joint movement.
6. Describe three methods of bone replacement or repair.
7. Use the following terms in one or more sentences that correctly relate their meaning: collagen, ligament, synovial, and tendon.

### Learning Objectives

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

### Key Terms

**Antagonist** (an-TAG-uh-nist) Muscle that acts in opposition to the action of another muscle, which is its agonist.

**Atrophy** (AT-ro-fe) Wasting away, decrease in size.

**Contraction** (kon-TRAK-shun) Shortening or development of tension in muscle tissue.

**Contracture** (kon-TRAK-chur) Permanent shortening of tendons and ligaments of a joint resulting from atrophy of muscle.

**Dystrophy** (DIS-truh-fe) Muscle disorder resulting from defective or faulty nutrition, abnormal development, or infection.

**Myalgia** (my-AL-je-uh) Muscle pain.

**Paralysis** (par-AL-ih-sis) Loss or impairment of motor function.

**Posture** (POS-chur) Attitude or position of the body.

**Prime mover** (prime MOO-ver) Muscle that acts directly to bring about a desired movement, agonist.

**Range of motion** (RAYLOG uhn MOH-uh-nuh) Active or passive movement of muscle groups to full extent possible, used to prevent contracture.

**Sarcocere** (SAR-kuh-mer) Repeating units of muscle fibers with the ability to contract.

**Skeletal** (SKEL-e-tal) Pertaining to the framework of the body.