# The Skeletal System

## Overview of Structures, Combining Forms, and Functions of the Skeletal System

<table>
<thead>
<tr>
<th>Major Structures</th>
<th>Related Combining Forms</th>
<th>Primary Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bones</td>
<td>oss/e, oss/i, oste/o, ost/o</td>
<td>Act as the framework for the body, protect the internal organs, and store the mineral calcium.</td>
</tr>
<tr>
<td>Bone Marrow</td>
<td>myel/o</td>
<td>Red bone marrow forms some blood cells.</td>
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<tr>
<td></td>
<td>(also means spinal cord)</td>
<td>Yellow bone marrow stores fat.</td>
</tr>
<tr>
<td>Cartilage</td>
<td>chondr/o</td>
<td>Creates a smooth surface for motion within the joints and protects the ends of the bones.</td>
</tr>
<tr>
<td>Joints</td>
<td>arthr/o</td>
<td>Work with the muscles to make a variety of motions possible.</td>
</tr>
<tr>
<td>Ligaments</td>
<td>ligament/o</td>
<td>Connect one bone to another.</td>
</tr>
<tr>
<td>Synovial Membrane</td>
<td>synovi/o, synov/o</td>
<td>Forms the lining of synovial joints and secretes synovial fluid.</td>
</tr>
<tr>
<td>Synovial Fluid</td>
<td>synovi/o, synov/o</td>
<td>Lubricant that makes smooth joint movements possible.</td>
</tr>
<tr>
<td>Bursa</td>
<td>burs/o</td>
<td>Cushions areas subject to friction during movement.</td>
</tr>
</tbody>
</table>
Vocabulary

The items on this list have been identified as key word parts and terms for this chapter. However, all words in boldface in the text are important and may be included in the learning exercises and tests.

Word Parts

- anky/o
- arthr/o
- chondr/o
- cost/o
- crani/o
- -desis
- kyph/o
- lord/o
- -lys is
- myel/o
- oss/e, oss/i, ost/o, oste/o
- scoli/o
- spondyl/o
- synovi/o, synov/o
- -um

Medical Terms

- acetabulum [ass-eh-TAB-you-lum]
- acetaminophen (ah-seet-ah-MIN-oh-fen)
- allogenic (al-oh-JEN-ick)
- ankylosing spondylitis (ang-kih-LOH-sing spon-dih-LYE-tis)
- ankylosis (ang-kih-LOH-sis)
- arthrodesis (ar-throh-DEE-sis)
- arthroplasty (AR-throh-plas-tee)
- arthroscopic surgery (ar-throh-SKOP-ick)
- autologous (aw-TOL-uh-guss)
- bursitis (ber-SIGH-tis)
- callus (KAL-us)
- chondroma (kon-DROH-mah)
- chondromalacia (kon-droh-mah-LAY-shee-ah)
- clavicle (KLAV-ih-kul)
- comminuted fracture (KOM-ih-newt-ed)
- craniectomy (kray-nee-EK-toh-mee)
- craniosclerosis (kray-nee-oh-steh-NOH-sis)
- craniotomy (kray-nee-OT-oh-mee)
- crepitation (krep-ih-TAY-shun)
- dual x-ray absorptiometry (ab-sorp-shee-OM-eh-tree)
- Ewing's sarcoma (YOU-ingz sar-KOH-mah)
- hallux valgus (HAL-ucks VAL-guss)
- hemarthrosis (hee-mahr-THROH-sis or hem-ar-THROH-sis)
- kyphosis (kiye-FOH-sis)
- laminectomy (lam-ih-NECK-toh-mee)
- lordosis (lor-DOH-sis)
- lumbago (lum-BAY-goh)
- luxation (luck-SAY-shun)
- myeloma (my-eh-LOH-mah)
- orthopedist (or-thoh-PEE-dist)
- orthotics (or-THOT-icks)
- osteitis (oss-tee-EYE-tis)
- osteoarthritis (oss-tee-oh-ar-THRIGH-tis)
- osteochondroma (oss-tee-oh-kon-DROH-mah)
- osteoclasia (oss-tee-OCK-lah-sis)
- osteomalacia (oss-tee-oh-mah-LAY-shee-ah)
- osteomyelitis (oss-tee-oh-my-eh-LYE-tis)
- osteopathic physician (oss-tee-oh-PATH-ick)
- osteopenia (oss-tee-oh-PEE-nee-ah)
- osteoporosis (oss-tee-oh-poh-ROH-sis)
- osteorhaphy (oss-tee-OR-ah-fee)
- osteotomy (oss-tee-OT-oh-mee)
- Paget's disease (PAJ-its)
- patella (pah-TEL-ah)
- percutaneous vertebroplasty (per-kyou-TAY-nee-us VER-tee-brob-plas-tee)
- phalanges (fah-LAN-jeez)
- podiatrist (poh-DYE-ah-trist)
- popliteal (pop-LITE-ee-al)
- rheumatism (ROO-mah-tizm)
- rheumatoid arthritis (ROO-mah-toyd ar-THRIGH-tis)
- rickets (RICK-ets)
- sacroiliac (say-kroh-IILL-ee-ack)
- scoliosis (skoh-lee-Oh-sis)
- spina bifida (SPY-nah BIF-ih-dah)
- spondylolisthesis (spon-dih-loh-liss-THEE-sis)
- subluxation (sub-luck-SAY-shun)
- synovectomy (sin-oh-VECK-toh-mee)
- talipes (TAL-ih-peez)
- thermal capsulorrhaphy (kap-soo-LOR-ah-fee)
- vertebral column (VER-tee-bral or VER-teh-bral)
OBJECTIVES

On completion of this chapter, you should be able to:

1. Identify and describe the major functions and structures of the skeletal system.
2. Describe three types of joints.
3. Differentiate between the axial and appendicular skeletons.
4. Identify the medical specialists who treat disorders of the skeletal system.
5. Recognize, define, spell, and pronounce terms related to the pathology and the diagnostic and treatment procedures of the skeletal system.

FUNCTIONS OF THE SKELETAL SYSTEM

The skeletal system has many important functions.

- Bones act as the framework of the body.
- Bones support and protect the internal organs.
- Joints working in conjunction with muscles, ligaments, and tendons make possible the wide variety of body movements. (Muscles and tendons are discussed in Chapter 4.)
- Calcium, which is required for normal nerve and muscle function, is stored in bones.
- Red bone marrow, which is located within spongy bone, has an important function in the formation of blood cells.

STRUCTURES OF THE SKELETAL SYSTEM

The structures of the skeletal system include bones, cartilage, ligaments, joints, and bursa.

THE STRUCTURE OF BONES

Bone is a form of connective tissue and is almost the hardest tissue in the human body. Only dental enamel is harder than bone.

The Tissues of Bone

Although it is very hard and dense, bone is a living structure that changes and is capable of healing itself. The tissues that make up a bone are summarized in Table 3.1 and shown in Figure 3.1.

Bone Marrow

- **Red bone marrow**, which is located within the spongy bone, is hemopoietic and manufactures red blood cells, hemoglobin, white blood cells, and thrombocytes. These types of blood cells are discussed in Chapter 5.

### Table 3.1

<table>
<thead>
<tr>
<th>Tissues of a Bone</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periosteum (per-ee-OSS-tee-um)</td>
<td>The tough, fibrous tissue that forms the outermost covering of bone (peri- means surrounding, oste means bone, and -um is a noun ending).</td>
</tr>
<tr>
<td>Compact Bone</td>
<td>The hard, dense, and very strong bone that forms the outer layer of the bones.</td>
</tr>
<tr>
<td>Spongy Bone</td>
<td>Lighter and not as strong as compact bone, it is commonly found in the ends and inner portions of long bones such as the femur. Red bone marrow is located within this spongy bone.</td>
</tr>
<tr>
<td>Medullary Cavity (MED-you-lehr-ee)</td>
<td>Located in the shaft of a long bone, the medullary cavity is surrounded by compact bone and contains yellow bone marrow. Medullary means pertaining to the inner section.</td>
</tr>
<tr>
<td>Endosteum (en-DOS-tee-um)</td>
<td>The tissue that forms the lining of the medullary cavity.</td>
</tr>
</tbody>
</table>
The meniscus (meh-NIS-kus) is the curved fibrous cartilage found in some joints, such as the knee and the temporomandibular joint of the jaw (Figure 3.4).

**Anatomic Landmarks of a Bone**
- The diaphysis (dye-AF-ih-sis) is the shaft of a long bone (Figure 3.1).
- The epiphysis (eh-PIF-ih-sis), which is covered with articular cartilage, is the wide end of a long bone.
- The proximal epiphysis is the end of the bone located nearest to the midline of the body.
- The distal epiphysis is the end of the bone located farthest away from the midline.
- A foramen (foh-RAY-men) is an opening in a bone through which blood vessels, nerves, and ligaments pass (plural, foramina). For example, the spinal cord runs through the vertebral foramen shown in Figure 3.13.
- A process is a normal projection on the surface of a bone that serves as an attachment for muscles and tendons. For example, the mastoid process is the bony projection located on each temporal bone just behind the ear (Figure 3.9).

**JOINTS**

Joints, also known as articulations, are connections between bones. As used here, articulation means to join or come together in a manner that allows motion between the parts. Articulation also means speaking clearly.

**Types of Joints**

Different types of joints make a wide range of motions possible. These types of joints include sutures, cartilaginous joints, and synovial joints.

**Sutures**
- A suture is an immovable joint. Here bones join along a jagged line to form a joint that does not move. Suture also means to stitch. Figure 3.2 shows the coronal and sagittal sutures across the top of the adult skull.
- The anterior and posterior fontanelles (fon-tab-NELLS) on a baby’s head are the regions where the sutures between the bones have not yet closed. These areas, also known as the soft spots, disappear as the child grows and the sutures close. This is also spelled fontanelles.
**Symphyses**

A symphysis (SIM-fihs), also known as an amphiarthrosis, is a form of cartilaginous joint (kar-thih-LADJ-ih-nus) that is only slightly moveable.

- In a symphysis, two bones join and are held firmly together so that they function as one bone (plural, synphyses). For example, the pubic symphysis is shown in Figure 3.15.

**Synovial Joints**

Synovial joints (sih-NOH-vee-all), also known as diarthrodial joints, are the movable joints of the body. Although these joints are described in simple terms, they are actually very complex structures (Figure 3.3).

- **Ball and socket joints**, such as the hips and shoulders, are synovial joints that allow a wide range of movement in many directions (Figure 3.3A).
- **Hinge joints**, such as the knees and elbows, are synovial joints that allow movement primarily in one direction or plane (Figures 3.3B and 3.3C).

### Structures of Synovial Joints

**Ligaments**

- A ligament (LIG-ah-ment) is a band of fibrous connective tissue that connects one bone to another bone. Figure 3.4 shows the complex system of ligaments that make knee movements possible.
- Be careful not to confuse ligaments and tendons. Tendons, which attach muscles to bones, are discussed in Chapter 4.

**Synovial Membrane and Fluid**

Synovial joints, which are surrounded by a fibrous capsule, are lined with synovial membrane. This specialized membrane secretes synovial fluid that acts as a lubricant to make the smooth movement of the joint possible (Figure 3.5).

**Bursa**

A bursa (BER-sah) is a fibrous sac that is lined with a synovial membrane and contains synovial fluid (plural, bursae).

- A bursa acts as a cushion to ease movement in areas that are subject to friction, such as in shoulder, elbow, and knee joints where a tendon passes over a bone (Figures 3.5 and 4.14).
**SKELETON**

The 206 bones in the adult human body are shown in Figures 3.6, 3.7, and 3.8. For descriptive purposes, the skeleton is divided into the axial and appendicular skeletal systems.

**Axial Skeleton**

- The **axial skeleton** (80 bones) protects the major organs of the nervous, respiratory, and circulatory systems. *Axial* means pertaining to an axis. An *axis* is an imaginary line that runs lengthwise through the center of the body.
- The axial skeleton consists of the skull, spinal column, ribs, and sternum. These structures are shown in gray in Figure 3.7.

**Appendicular Skeleton**

- The **appendicular skeleton** (126 bones) makes body movement possible and also protects the organs of digestion, excretion, and reproduction. The term *appendicular* means referring to an appendage. An *appendage* is anything that is attached to a major part of the body.
- The appendicular skeleton is organized into the **upper extremities** (shoulders, arms, forearms, wrists, and hands) and the **lower extremities** (hips, thighs, legs, ankles, and feet). These structures are shown in blue in Figure 3.7.
Bones of the Skull

The skull consists of eight bones that form the cranium, 14 bones that form the face, and six tiny bones in the middle ear. As you study the following bones of the skull, refer to Figures 3.9 and 3.10.

Bones of the Cranium

The cranium (KRAY-nee-um) is the portion of the skull that encloses the brain (crani means skull and -um is a noun ending). The cranium is made up of the following eight bones:
- The frontal bone forms the forehead.
- The two parietal bones (pah-RYE-eh-tal) form most of the roof and upper sides of the cranium.
- The occipital bone (ock-SIP-ih-tal) forms the posterior floor and walls of the cranium. The spinal cord passes through the foramen magnum of the occipital bone.
- The two temporal bones form the sides and base of the cranium.

Auditory Ossicles

The six auditory ossicles (OSS-ih-kuh-lye) are discussed in Chapter 11.
- The external auditory meatus (mee-AY-tus) is located in the temporal bone. A meatus is the external opening of a canal.

Bones of the Face

The face is made up of the following 14 bones:
- The two nasal bones form the upper part of the bridge of the nose.
- The two zygomatic bones (zye-goh-MAT-ick), also known as the cheekbones, articulate with the frontal bones.
Figure 3.9  Lateral view of the adult human skull.

Figure 3.10  Anterior view of the adult human skull.
The two **maxillary bones** (MACK-sih-lar-ee), also known as the **maxillae**, form most of the upper jaw (singular, **maxilla**).

The two **palatine bones** (PAL-ah-tine) form part of the hard palate of the mouth and the floor of the nose.

The two **lacrimal bones** (LACK-rih-mal) make up part of the orbit at the inner angle of the eye.

The two **inferior conchae** (KONG-kee or KONG-kay) are the thin, scroll-like bones that form part of the interior of the nose (singular, **concha**).

The **vomer bone** (VOH-mer) forms the base for the nasal septum. The **nasal septum** is the cartilage structure that divides the two nasal cavities.

The **mandible** (MAN-dih-bul), also known as the **lower jawbone**, is the only movable bone of the skull. The mandible is attached to the skull at the **temporomandibular joint** (tem-poh-rah-man-DIB-you-law) (TMJ).

**Thoracic Cavity**

The **thoracic cavity** (thoh-RAS-ick), which is part of the axial skeleton, is made up of the ribs, sternum, and thoracic vertebrae (Figure 3.6). Also known as the **rib cage**, this structure protects the heart and lungs.

**Ribs**

There are 12 pairs of ribs, called **costals** (KOSS-tulz), which attach posteriorly to the thoracic vertebrae (cost means rib and -al means pertaining to).

- The first seven pairs of ribs, called **true ribs**, are attached anteriorly to the sternum (Figure 3.11).
- The next three pairs of ribs, called **false ribs**, are attached anteriorly to cartilage that joins with the sternum.
- The last two pairs of ribs, called **floating ribs**, are not attached anteriorly.

**Sternum**

The **sternum** (STER-num), also known as the **breastbone**, forms the middle of the front of the rib cage. It is divided into three parts: the manubrium, body, and xiphoid process (Figure 3.11).

- The **manubrium** (mah-NEW-bree-um), which is bone, forms the upper portion of the sternum.
- The **body** of the sternum, which is bone, forms the middle portion of the sternum.
- The **xiphoid process** (ZIF-oid), which is cartilage, forms the lower portion of the sternum.

**Shoulders**

The shoulders form the **pectoral girdle** (PECK-toh-ral), which supports the arms and hands; this is also known as the **shoulder girdle**. As used here, the term **girdle** means a structure that encircles the body. As you study the bones of the shoulder, refer to Figures 3.8 and 3.11.

- The **clavicle** (KLAV-ih-kul), also known as the **collar bone**, is a slender bone that connects the manubrium of the sternum to the scapula.
- The **scapula** (SKAP-you-lah) is also known as the **shoulder blade** (plural, **scapulae**).
- The **acromion** (ah-KROH-mee-on) is an extension of the scapula that forms the high point of the shoulder.

**Arms**

As you study the following bones of the arms, refer to Figures 3.11 and 3.12.

- The **humerus** (HEW-mer-us) is the bone of the upper arm (plural, **humeri**).
- The **radius** (RAY-dee-us) is the smaller bone in the forearm. The radius runs up the thumb side of the forearm.
The **ulna** (ULL-nah) is the larger bone of the forearm. It articulates with the humerus to form the elbow joint.

The **olecranon process** (oh-LEK-rahn-non), commonly known as the **funny bone**, is a large projection on the upper end of the ulna that forms the point of the elbow that tinges when struck.

**Wrist, Hands, and Fingers**

As you study the following bones of the wrists and hands, refer to Figure 3.12.

- The 16 **carpals** (KAR-palz) are the bones that form the wrists.
- The 10 **metacarpals** (met-ah-KAR-palz) are the bones that form the palms of the hands.
- The 28 **phalanges** (fah-LAN-jeez) are the bones of the fingers (singular, phalanx). The term phalanges also describes the bones of the feet.
- Each finger has three bones. These are the **distal** (outermost), **medial** (middle), and **proximal** (nearest the hand) phalanges.
- The thumb has two bones. These are the **distal** and **proximal** phalanges.

**Vertebral Column**

The **vertebral column** (VER-teh-bral or VER-tee-bral), also known as the **spinal column**, consists of 26 **vertebrae** (VER-teh-bray) (singular, **vertebra**). The term vertebral means pertaining to the vertebrae.

- The functions of the spinal column are to support the head and body and to protect the spinal cord.

**Structures of Vertebrae**

As you study the following structures, refer to Figure 3.13.

- The **body** is the solid anterior portion of a vertebra.
- A **lamina** (LAM-ih-nah) is the posterior portion of a vertebra (plural, **laminae**). The transverse and spinous processes extend from this area.
- The **vertebral foramen** is the opening in the middle of the vertebra. The spinal cord passes through this opening.

**Types of Vertebrae**

As you study the types of vertebrae, refer to Figure 3.14.

- The **cervical vertebrae** (SER-vih-kal) are the first set of seven vertebrae that form the neck. They are also known as **C1** through **C7**. Cervical means pertaining to the neck.
- The **thoracic vertebrae** (thoh-RASS-ick) make up the second set of 12 vertebrae. They form the outward curve of the spine and are known as **T1** through **T12**.
- The **lumbar vertebrae** (LUM-bar) make up the third set of five vertebrae and form the inward curve of the lower spine. They are known as **L1** through **L5**. The lumbar vertebrae are the largest and strongest of the vertebrae and bear most of the body’s weight.

**Intervertebral Disks**

The **intervertebral disks** (in-ter-VER-teh-bral), which are made of cartilage, separate and cushion the vertebrae from each other. These disks act as shock absorbers and allow for movement of the spinal column (Figure 3.21A).
**Sacroiliac** (say-kroh-ILL-ee-ack) is the slightly movable articulation between the sacrum and posterior portion of the ilium (sacr/o means sacrum, ili means ilium, and -ac means pertaining to).

- The **ischium** (ISS-kee-um), which forms the lower posterior portion of the pubic bone, bears the weight of the body while sitting.

**Pelvic Girdle**

The pelvic girdle, which protects internal organs and supports the lower extremities, is also known as the **pelvis** or **hips**. This structure consists of the ilium, ischium, and pubis (Figure 3.15).

- The **ilium** (ILL-ee-um) is the broad blade-shaped bone that forms the back and sides of the pubic bone. Memory aid: This is spelled with the letter i as in the word hip.
- The pubis (PEW-bis), which forms the anterior portion of the pubic bone, is located just below the urinary bladder.

- The ilium, ischium, and pubis are separate at birth; however, they fuse to form the left and right pubic bones. These bones are held securely together by the pubic symphysis.

- The pubic symphysis (PEW-bick SIM-fih-sis), which is the cartilaginous joint formed at the anterior midline, holds the bones firmly together.

- The acetabulum (ass-eh-TAB-you-lum), also known as the hip socket, is the large circular cavity in each side of the pelvis that articulates with the head of the femur to form the hip joint (Figure 3.15).

**Legs and Knees**

As you study the following bones, refer to Figures 3.16 and 3.17.

**Femur**

The femur (FEE-mur) is the upper leg bone (Figure 3.16). Also known as the thigh bone, it is the largest bone in the body.

- The head of the femur articulates with the acetabulum (hip socket).

- The femoral neck (FEM-or-al) is the narrow area just below the head of the femur. Femoral means pertaining to the femur.

**Knees**

The knees are the complex joints that make possible movement between the upper and lower leg.

- The patella (pah-TEL-ah) is the bony anterior portion of the kneecap.

- The term popliteal (pop-LIT-ee-al) refers to the posterior surface of the knee and is used to describe the space, ligaments, vessels, and muscles in this area.

- The anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL), which are shown in Figure 3.4, make possible the movements of the knee. These are known as cruciate ligaments (KROO-shhee-ayt) because they are shaped like a cross.

**Lower Leg**

The lower leg is made up of two bones: the tibia and the fibula (Figure 3.16).
• The **tibia** (TIB-ee-ah), also known as the **shinbone**, is the larger weight-bearing bone in the anterior of the lower leg.

• The **fibula** (FIB-you-lah) is the smaller of the two bones of the lower leg.

**The Ankles**

The **tarsals** (TAHR-salz) are the five bones that make up each of the ankles (Figure 3.18).

• The **malleolus** (mal-LEE-oh-lus) is the rounded bony protuberance on each side of the ankle (plural, **malleoli**).

• The **talus** (TAY-luss) is the anklebone that articulates with the tibia and fibula (Figure 3.18).

• The **calcaneus** (kal-KAY-nee-us), or **heel bone**, is the largest of the tarsal bones (Figure 3.18).

**The Feet and Toes**

• The five **metatarsals** (met-ah-TAHR-salz) form the part of the foot to which the toes are attached.

• The **phalanges** (fah-LAN-jeez) are the bones of the toes (singular, **phalanx**). The great toe has two phalanges. Each of the other toes has three phalanges. The term **phalanges** also means fingers.

**MEDICAL SPECIALTIES RELATED TO THE SKELETAL SYSTEM**

• A **chiropractor** (KYE-roh-prack-tor) holds a Doctor of Chiropractic degree and specializes in the manipulative treatment of disorders originating from misalignment of the spine.

• An **orthopedic surgeon**, also known as an **orthopedist** (or-thoh-PEE-dist), specializes in diagnosing
and treating diseases and disorders involving the bones, joints, and muscles.

- **Orthotics** (or-THOT-icks) is the field of knowledge relating to the making and fitting of orthopedic appliances, such as a brace or splint to support, align, prevent, or correct deformities or to improve the function of movable parts of the body.

- An **osteopathic physician** (oss-tee-oh-PATH-ick) holds a Doctor of Osteopathy degree and uses traditional forms of medical treatment in addition to specializing in treating health problems by spinal manipulation. This type of medical practice is known as **osteopathy** (oss-tee-OP-ah-thee); however, this term also means any bone disease (oste/o means bone and -pathy means disease). As used here, *manipulation* means changing the positions of the bones.

- A **podiatrist** (poh-DYE-ah-trist) holds a Doctor of Podiatry (DP) or Doctor of Podiatric Medicine (DPM) degree and specializes in diagnosing and treating disorders of the foot (pod mean foot and -iatrist means specialist).

- A **rheumatologist** (roo-mah-TOL-oh-jist) is a physician who specializes in the diagnosis and treatment of rheumatic diseases that are characterized by inflammation in the connective tissues.

- **Rheumatism** (ROO-mah-tizm) is a general term for a variety of acute and chronic conditions characterized by inflammation and deterioration of connective tissues. This group of disorders includes joint diseases such as arthritis and muscle disorders such as fibromyalgia (see Chapter 4).

- A **chondroma** (kon-DROH-mah) is a slow-growing benign tumor derived from cartilage cells (chondr means cartilage and -oma means tumor).

- **Chondromalacia** (kon-droh-mah-LAY-shee-ah) is the abnormal softening of the cartilage (chondr/o means cartilage and -malacia means abnormal softening).

- **Hallux valgus** (HAL-ucks VAL-guss), also known as a bunion, is an abnormal enlargement of the joint at the base of the great toe (hallux means big toe and valgus means bent).

- **Hemarthrosis** (hee-mahr-THROH-sis) or **hemarthrosis** (hem-arthro-sis) is blood within a joint space (hem means blood, arthr means joint, and -osis means abnormal condition). This condition occurs after trauma to a joint. It may also occur spontaneously in a patient who is receiving blood-thinning medications (see Chapter 5) or in individuals with a blood-clotting disorders such as hemophilia (see Chapter 2).

- **Synovitis** (sin-oh-VYE-tiss) is inflammation of the synovial membrane that results in swelling and pain of the affected joint (synov means synovial membrane and -itis means inflammation). This condition may be caused by an injury, infection, or irritation produced by damaged cartilage.

**Dislocation**

- **Dislocation**, also known as **luxation** (luck-SAY-shun), is the total displacement of a bone from its joint (Figure 3.19).

- **Subluxation** (sub-luck-SAY-shun) is the partial displacement of a bone from its joint.

**Arthritis**

**Arthritis** (ar-THRIGH-tis) is an inflammatory condition of one or more joints (arthr means joint and -itis means inflammation). There are many different forms and causes of arthritis (plural, arthritis).

- **Osteoarthritis** (oss-tee-oh-ar-THRIGH-tis), also known as **wear-and-tear arthritis**, is most commonly associated with aging (oste/o means bone, arthr means joint, and -itis means inflammation). OA is described as a degenerative joint disease (DJD) because it is characterized by the erosion of articular cartilage (Figure 3.20). Erosion means wearing away by friction or pressure.

- **Gouty arthritis** (GOW-tee-ar-THRIGH-tis), also known as **gout**, is a type of arthritis caused by an
excess of uric acid in the body. Gout occurs as episodes of sudden, severe attacks of pain and tenderness, redness, warmth, and swelling in the affected joints.

Rheumatoid Arthritis

Rheumatoid arthritis (ROO-mah-toyd ar-THRIGH-tis) is an autoimmune disorder in which the symptoms are generalized and usually more severe than those of osteoarthritis. In rheumatoid arthritis, the synovial membranes are inflamed and thickened. Other tissues are also attacked, causing the joints to become swollen, painful, and immobile.

- **Ankylosing spondylitis** (ang-kih-LOH-sing spon-dih-LYE-tis) is a form of rheumatoid arthritis characterized by progressive stiffening of the spine due to the fusion of the vertebral bodies. *Ankylosing* means the progressive stiffening of a joint or joints. *Spondylitis* means the inflammation of the vertebrae (*spondyl* means vertebrae and *-itis* means inflammation).

- **Juvenile rheumatoid arthritis**, also known as juvenile idiopathic arthritis, affects children. Symptoms include pain and swelling in the joints, skin rash, fever, slowed growth, and fatigue (*idiopathic* means of unknown cause).

Spinal Column

- A **herniated disk** (HER-nee-ayt-ed), also known as a **ruptured disk**, is the breaking apart of an intervertebral disk that results in pressure on spinal nerve roots (Figure 3.21B).

- **Lumbago** (lum-BAY-goh), also known as **low back pain**, is pain of the lumbar region of the spine (lumb means lumbar and *-ago* means diseased condition) (Figure 3.14).

- **Spondylolisthesis** (spon-dih-loh-liss-THEE-sis) is the slipping forward movement of the body of one
of the lower lumbar vertebra on the vertebra below it, or on the sacrum (spondyl/o means vertebrae and -listhesis means slipping).

- **Spondylosis** (spon-dih-LOH-sis) is any degenerative disorder that may cause loss of normal spinal structure and function (spondyl means vertebrae and -osis means abnormal condition). The adjective degenerative describes the breaking down or impairment of a body part.

**Spina Bifida**

**Spina bifida** (SPY-nah BIF-ih-dah) is the congenital defect that occurs during early pregnancy in which the spinal canal fails to close around the spinal cord. (Spina means pertaining to the spine and bifida means split.) Many cases of spina bifida are due to a lack of the nutrient folic acid during the early stages of pregnancy.

**Curvatures of the Spine**

- **Kyphosis** (kye-FOH-sis) is an abnormal increase in the outward curvature of the thoracic spine as viewed from the side (kyph means hump and -osis means abnormal condition). This condition is also known as humpback or dowager’s hump (Figure 3.22A).

- **Lordosis** (lor-DOH-sis) is an abnormal increase in the forward curvature of the lumbar spine (lord means bent backward and -osis means abnormal condition). This condition is also known as swayback (Figure 3.22B).

- **Scoliosis** (skoh-lee-OH-sis) is an abnormal lateral (sideways) curvature of the spine (scoli means curved and -osis means abnormal condition) (Figure 3.22C).

**Bones**

- **Craniostenosis** (kray-nee-oh-steh-NOH-sis) is a malfunction of the skull due to the premature closure of the cranial sutures (crani/o means skull and -stenosis means abnormal narrowing).

- **Ostealgia** (oss-tee-AL-jee-ah), also spelled ostalgia or known as osteodynia, means pain in a bone (ost and oste both mean bone and -algia and -dynia both mean pain).

- **Osteitis** (oss-tee-EYE-tis), which is also spelled ostitis, is an inflammation of bone (oste means bone and -itis means inflammation).

- **Osteomalacia** (oss-tee-oh-mah-LAY-shee-ah), also known as adult rickets, is abnormal softening of bones in adults that is usually caused by a deficiency of vitamin D, calcium, or phosphate (oste/o means bone and -malacia means abnormal softening). Compare with rickets.

- **Osteomyelitis** (oss-tee-oh-my-eh-LYE-tis) is an inflammation of the bone marrow and adjacent bone (oste/o means bone, myel means bone marrow, and -itis means inflammation).

- **Osteonecrosis** (oss-tee-oh-neh-KROH-sis) is the destruction and death of bone tissue caused by an insufficient blood supply, infection, malignancy, or trauma (oste/o means bone and -necrosis means tissue death).

---

**Figure 3.22** Abnormal curvatures of the spine. (A) Kyphosis. (B) Lordosis. (C) Scoliosis. (Normal curvatures are shown in shadow.)
Paget’s disease (PAJ-its), also known as osteitis deformans (oss-tee-EYE-tis dee-FOR-manz), is a disease of unknown cause that is characterized by extensive bone destruction followed by abnormal bone repair. As the disease progresses, the bones become deformed and weakened and may bend or break easily.

Periostitis (pehr-ee-oss-TYE-tis), which is also spelled periostitis, is an inflammation of the periostea (peri- means surrounding, ost means bone, and -itis means inflammation).

Rickets (RICK-ets), which occurs in children, is a disorder involving softening and weakening of the bones primarily caused by lack of vitamin D, calcium, or phosphate. Compare with osteomalacia.

Talipes (TAL-iib-peez), also known as clubfoot, is a congenital deformity in which the foot is turned outward or inward as shown in Figure 3.23. This is so named because it involves the talus bone of the ankle.

Tumors of Bones

Malignancies and tumors are discussed further in Chapter 6.

Ewing’s sarcoma (YOU-ingz sar-KOH-mah), also known as Ewing’s family of tumors, is a group of cancers that most frequently affects children or adolescents. A sarcoma is a malignant tumor of connective tissue, and in Ewing’s sarcoma these tumors usually occur in the diaphyses of the long bones in the arms and legs. The disease may spread rapidly to other body sites.

A myeloma (myeh-LOH-mah) is a malignant tumor composed of blood-forming tissues of the bone marrow (myel means bone marrow and -oma means tumor). Myeloma may cause pathological fractures, and is often fatal.

An osteochondroma (oss-tee-oh-kon-DROH-mah) is a benign bone tumor characterized by cartilage-capped bony growth that projects from the surface of the affected bone (oste/o means bone, chondr means cartilage, and -oma means tumor). This type of tumor is also known as an exostosis (eck-sos-TOH-sis) (plural, exostoses).

Osteoporosis

Osteoporosis (oss-tee-oh-poh-ROH-sis) is a marked loss of bone density and an increase in bone porosity that is frequently associated with aging (oste/o means bone, por means small opening, and -osis means abnormal condition).

Osteopenia (oss-tee-oh-PEE-neee-ah) is thinner than average bone density in a young person (oste/o means bones and -penia means deficiency). This term is used to describe the condition of someone who does not yet have osteoporosis, but is at risk for developing it.

Osteoporotic Fractures

Osteoporosis is primarily responsible for three types of fractures:

Vertebral crush fractures, also known as compression fractures of the spine, are caused by the spontaneous collapse of weakened vertebrae. This results in pain, loss of height, and development of the spinal curvature known as dowager’s hump. These changes cause mobility problems, the crowding of the internal organs, and a reduction in lung capacity (Figure 3.24).

Colles’ fracture, also known as a fractured wrist, occurs at the lower end of the radius when a person tries to break a fall by landing on his or her hands. The impact of this fall causes the weakened bone to break (Figure 3.25).

An osteoporotic hip fracture (oss-tee-oh-pah-ROT-ick), also known as a broken hip, can occur spontaneously or as the result of a fall. Complications from these fractures may result in the loss of function, mobility, independence, or death.
Fractures

A fracture, which is a broken bone, is described in terms of its complexity (Figure 3.26).

- A closed fracture, also known as a simple or complete fracture, is one in which the bone is broken but there is no open wound in the skin (see also Figure 3.27). Compare with an open fracture.

- An open fracture, also known as a compound fracture, is one in which the bone is broken and there is an open wound in the skin. Compare with a closed fracture.

- A comminuted fracture (KOM-ih-newt-ed) is one in which the bone is splintered or crushed. Comminuted means crushed into small pieces.

- A compression fracture occurs when the bone is pressed together (compressed) on itself (see Osteoporosis).

- A greenstick fracture, or incomplete fracture, is one in which the bone is bent and only partially broken. This type of fracture occurs primarily in children.

- An oblique fracture occurs at an angle across the bone.

- A pathologic fracture occurs when a bone, weakened due to a disease process, such as cancer, breaks under normal strain.

- A spiral fracture is a fracture in which the bone has been twisted apart. This occurs as the result of a severe twisting motion as in a sports injury.

- A stress fracture, which is an overuse injury, is a small crack in the bone that often develops from chronic, excessive impact. Overuse and sports injuries are discussed in Chapter 4.

- A transverse fracture occurs straight across the bone.

Additional Terms Associated with Fractures

- A fat embolus (EM-boh-lus) may form when a long bone is fractured and fat cells from yellow bone
marrow are released into the blood. An embolus is any foreign matter circulating in the blood that may become lodged and block the blood vessel.

- Crepitation (krep-ih-TAY-shun), also known as crepitus (KREP-ih-tus), is the crackling sound heard when the ends of a broken bone move together. The term crepitation also describes the sound heard in lungs affected with pneumonia and with the noisy discharge of gas from the intestine.
- As the bone heals, a callus (KAL-us) forms a bulging deposit around the area of the break. This tissue eventually becomes bone. A callus is also a thickening of the skin that is caused by repeated rubbing.

**DIAGNOSTIC PROCEDURES OF THE SKELETAL SYSTEM**

- **Radiographs**, also known as x-rays, are used to visualize bone fractures and other abnormalities (Figure 3.27).

- **Arthroscopy** (ar-THROS-koh pee) is the visual examination of the internal structure of a joint (arthr/o means joint and -scopy means visual examination) using an arthroscope (Figure 3.28).

- A bone marrow biopsy is a diagnostic test to determine why blood cells are abnormal or to find a donor match for a bone marrow transplant. This test is performed by inserting a sharp needle into the hipbone or sternum and removing bone marrow cells.

- **Magnetic resonance imaging** is used to image soft tissue structures such as the interior of complex joints. It is not the most effective method of imaging hard tissues such as bone.

- **Bone scans**, a form of nuclear medicine, and **arthrocentesis** are discussed in Chapter 15.

**Bone Density Testing**

Bone density testing is used to determine losses or changes in bone density. These tests are indicated for conditions such as osteoporosis, osteomalacia, and Paget's disease.

- **Ultrasonic bone density testing** is a screening test for osteoporosis or other conditions that cause a loss of bone mass. In this procedure sound waves are used to take measurements of the calcaneus (heel) bone. If the results indicate risks, more definitive testing is indicated.

- **Dual x-ray absorptiometry** (ab-sorp-shee-OM-eh-tree) produces more definitive results than ultrasonic bone density testing. DXA is a low-exposure radiographic measurement of the spine and hips that is able to detect early signs of osteoporosis.

**TREATMENT PROCEDURES OF THE SKELETAL SYSTEM**

**Medications**

- **Nonsteroidal anti-inflammatory drugs**, also known as NSAIDs, are administered to control pain and to reduce inflammation and swelling. Medications in this group may also thin the blood and attack the stomach lining. Examples of over-the-counter NSAIDs include aspirin, ibuprofen
• COX-2 inhibitors control the pain and inflammation of osteoarthritis and rheumatoid arthritis with fewer side effects than with NSAIDs. These medications are named for the two cyclooxygenase (COX) enzymes that are associated with arthritic pain and inflammation.

Bone Marrow Transplants

A bone marrow transplant, also known as a stem cell transplant, is used to treat certain types of cancers, such as leukemia and lymphomas, that affect bone marrow. Stem cells are discussed in Chapter 2, leukemia is discussed in Chapter 5, and lymphomas are discussed in Chapter 6.

• In this treatment, both the cancer and the patient’s bone marrow are destroyed with high-intensity radiation and chemotherapy.

• Next, healthy stem cells are transfused into the recipient’s blood. These cells migrate to the spongy bone, where they grow into cancer-free red bone marrow.

Autologous Bone Marrow Transplant

In an autologous (aw-TOL-uh-guss) bone marrow transplant, the patient receives his own bone marrow, which was harvested before treatment began. Autologous means originating within an individual.

Allogenic Bone Marrow Transplant

An allogenic (al-oh-JEN-ick) bone marrow transplant may be a possibility if the patient’s bone marrow cannot be utilized. In this type of transplant, the recipient (patient) receives bone marrow from a donor. However, unless this is a perfect match, there is the danger that the recipient’s body will reject the transplant. Allogenic means originating within another.

Joints

• Arthrodesis (ar-throh-DEE-sis), also known as fusion or surgical ankylosis, is a surgical procedure to stiffen a joint, such as an ankle, elbow, or shoulder (arthr/o means joint and -desis means surgical fixation of bone or joint). This procedure is performed to treat severe arthritis or a damaged joint. Compare with arthrolysis.

• Arthrolysis (ar-THROL-ih-sis) is the surgical loosening of an ankylosed joint (arthr/o means joint and -lysis means loosening or setting free). Note: The suffix -lysis also means breaking down or
destruction and may indicate either a pathologic state or a therapeutic procedure. Compare with *arthrodesis*.

- **Arthroscopic surgery** (ar-thro-SKOPE-ICK) is a minimally invasive procedure for the treatment of the interior of a joint. For example, torn cartilage may be removed with the use of an arthroscope and instruments inserted through small incisions (Figure 3.28).

- A **bursa** (ber-SHK-uh) is the surgical removal of a bursa (burs means the bursa and -ectomy means surgical removal).

- **Chondroplasty** (kon-DROH-plas-TEE) is the surgical repair of damaged cartilage (chondr/o means cartilage and -plasty means surgical repair).

- A **synovectomy** (sin-oh-SHOCK-uh) is the surgical removal of a synovial membrane from a joint (synov means synovial membrane and -ectomy means surgical removal). This procedure is performed to repair joint damage caused by rheumatoid arthritis.

- A **thermal capsulorrhaphy** (kayp-foo-LOR-uh) is an arthroscopic technique in which heat is used to shrink and tighten the tissues involved in shoulder instability disorders.

**Joint Replacement**

Joint replacement surgery is a common procedure performed to replace a damaged joint with an artificial joint. **Arthroplasty** (AR-throh-plas-TEE) means joint and -plasty means surgical repair; however, this term also has come to mean the surgical replacement of a joint with an artificial joint. These procedures are performed for a variety of reasons, including arthritis, trauma, and other joint disorders.

- The replacement part is a **prosthesis** (pros-THEE-sis), which is also known as an **implant** (Figure 3.29). The broader definition of prosthesis is a substitute for a diseased or missing part of the body (plural, prostheses).

- A **total knee replacement** means that all of the parts of the knee were replaced. This procedure is also known as a **total knee arthroplasty** (Figure 3.30).

- A **partial knee replacement** (PKR) means that only part of the knee was replaced.

- A **total hip replacement**, also known as a **total hip arthroplasty**, consists of a metal shaft with a ball at the top and a plastic lined cup. The metal shaft is fitted into the femur. The metal ball fits into the plastic lined cup that replaces the acetabulum within the hipbone (see Figure 3.29).

- **Revision surgery** is the replacement of a worn or failed implant.

**Spinal Column**

- A **percutaneous diskectomy** (per-kyou-TAY-nee-us dis-KECK-uh-SEEK) is performed to treat a herniat-
ed disk. In this procedure a thin tube is inserted through the skin of the back to suction out the ruptured disk or to vaporize it with a laser. Percutaneous means performed through the skin.

- A percutaneous vertebroplasty (per-kyou-TAY-nee-us VER-tee-broh-plas-tee) is performed to treat osteoporosis-related compression fractures (vertebr/o means vertebra and -plasty means surgical repair). In this minimally invasive procedure, bone cement is injected to stabilize compression fractures within the spinal column.

- A laminectomy (lam-ih-NECK-toh-mee) is the surgical removal of a lamina from a vertebra (lamin means lamina and -ectomy means surgical removal).

- Spinal fusion is a technique to immobilize part of the spine by joining together (fusing) two or more vertebrae. Fusion means to join together.

**Bones**

- A cranectomy (kray-nee-EK-toh-mee) is the surgical removal of a portion of the skull (crani means skull and -ectomy means surgical removal). This procedure is performed to treat craniostenosis.

- A craniotomy (kray-nee-OT-oh-mee), also known as a bone flap, is a surgical incision or opening into the skull (crani means skull and -otomy means a surgical incision). This procedure is performed to gain access to the brain to remove a tumor or to relieve intracranial pressure (Figure 3.31). Intracranial pressure is discussed in Chapter 10.

- A cranioplasty (KRAY-nee-oh-plas-tee) is the surgical repair of the skull (crani/o means skull and -plasty means surgical repair).

- Osteoclasis (oss-tee-OCK-lah-sis) is the surgical fracture of a bone to correct a deformity (oste/o means bone and -clasis means to break).

- An osteotomy (oss-TECK-toh-mee) is the surgical removal of bone (ost means bone and -ectomy means the surgical removal).

- Osteoplasty (OSS-tee-oh-plas-tee) is the surgical repair of a bone or bones (oste/o means bone and -plasty means surgical repair).
A craniotomy is performed to gain access to a portion of the brain.

- **Osteorrhaphy** (oss-tee-OR-ah-fee) is the surgical suturing, or wiring together, of bones (oste/o means bone and -rhaphy means surgical suturing).
- **Osteotomy** (oss-tee-OH-oh-mee) is a surgical incision or sectioning of a bone (oste means bone and -otomy means a surgical incision).
- A **periosteotomy** (pehr-ea-oss-tee-OH-oh-mee) is an incision through the periosteum to the bone (peri- means surrounding, oste means bone, and -otomy means surgical incision).

**Figure 3.32** Closed reduction of a fractured left humerus.

**Treatment of Fractures**

- **Manipulation**, also known as **closed reduction**, is the attempted realignment of the bone involved in a fracture or joint dislocation. The affected bone is returned to its normal anatomic alignment by manually applied forces and then is usually immobilized to maintain the realigned position during healing (Figure 3.32).
- **Traction** is a pulling force exerted on a limb in a distal direction in an effort to return the bone or joint to normal alignment.
- **Immobilization**, also known as **stabilization**, is the act of holding, suturing, or fastening the bone in a fixed position with strapping or a cast.

**External and Internal Fixation**

- **External fixation** is a fracture treatment procedure in which pins are placed through the soft tissues and bone so that an external appliance can be used to hold the pieces of bone firmly in place during healing. When healing is complete, the appliance is removed (Figure 3.33).
Internal fixation, which is also known as open reduction internal fixation (ORIF), is a fracture treatment in which pins or a plate are placed directly into the bone to hold the broken pieces in place. This form of fixation is not usually removed after the fracture has healed (Figure 3.34).

**ABBREVIATIONS RELATED TO THE SKELETAL SYSTEM**

Table 3.2 presents an overview of the abbreviations related to the terms introduced in this chapter. **Note:** To avoid errors or confusion, always be cautious when using abbreviations.

<table>
<thead>
<tr>
<th>Abbreviations Related to the Skeletal System</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>acetaminophen = APAP</td>
<td>APAP = acetaminophen</td>
</tr>
<tr>
<td>bone density testing = BDT</td>
<td>BDT = bone density testing</td>
</tr>
<tr>
<td>bone marrow biopsy = BMB</td>
<td>BMB = bone marrow biopsy</td>
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<tr>
<td>bone marrow transplant = BMT</td>
<td>BMT = bone marrow transplant</td>
</tr>
<tr>
<td>closed reduction = CR</td>
<td>CR = closed reduction</td>
</tr>
<tr>
<td>craniostenosis = CSO</td>
<td>CSO = craniostenosis</td>
</tr>
<tr>
<td>dual x-ray absorptiometry = DXA</td>
<td>DXA = dual x-ray absorptiometry</td>
</tr>
<tr>
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<td>Fx = fracture</td>
</tr>
<tr>
<td>hallux valgus = HV</td>
<td>HV = hallux valgus</td>
</tr>
<tr>
<td>juvenile rheumatoid arthritis = JRA</td>
<td>JRA = juvenile rheumatoid arthritis</td>
</tr>
<tr>
<td>magnetic resonance imaging = MRI</td>
<td>MRI = magnetic resonance imaging</td>
</tr>
</tbody>
</table>
### Table 3.2 (continued)

**Abbreviations Related to the Skeletal System**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>nonsteroidal anti-inflammatory drug = NSAID</td>
<td>NSAID = nonsteroidal anti-inflammatory drug</td>
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<tr>
<td>osteoarthritis = OA</td>
<td>OA = osteoarthritis</td>
</tr>
<tr>
<td>osteoporosis = OP</td>
<td>OP = osteoporosis</td>
</tr>
<tr>
<td>open reduction internal fixation = ORIF</td>
<td>ORIF = open reduction internal fixation</td>
</tr>
<tr>
<td>partial knee replacement = PKR</td>
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</tr>
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<td>RA = rheumatoid arthritis</td>
</tr>
<tr>
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<td>SB = spina bifida</td>
</tr>
<tr>
<td>total hip arthroplasty = THA</td>
<td>THA = total hip arthroplasty</td>
</tr>
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<tr>
<td>total knee replacement = TKR</td>
<td>TKR = total knee replacement</td>
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### Matching Word Parts 1

Write the correct answer in the middle column.

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<tr>
<th>Definition</th>
<th>Correct Answer</th>
<th>Possible Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1. hump</td>
<td></td>
<td>ankylo</td>
</tr>
<tr>
<td>3.2. cartilage</td>
<td></td>
<td>arthr/o</td>
</tr>
<tr>
<td>3.3. crooked, bent, or stiff</td>
<td></td>
<td>-um</td>
</tr>
<tr>
<td>3.4. joint</td>
<td></td>
<td>kyph/o</td>
</tr>
<tr>
<td>3.5. noun ending</td>
<td></td>
<td>chondro</td>
</tr>
</tbody>
</table>

### Matching Word Parts 2

Write the correct answer in the middle column.

<table>
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<tr>
<th>Definition</th>
<th>Correct Answer</th>
<th>Possible Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.6. cranium, skull</td>
<td></td>
<td>cost/o</td>
</tr>
<tr>
<td>3.7. rib</td>
<td></td>
<td>crani/o</td>
</tr>
<tr>
<td>3.8. setting free, loosening</td>
<td></td>
<td>-desis</td>
</tr>
<tr>
<td>3.9. spinal cord, bone marrow</td>
<td></td>
<td>-lysis</td>
</tr>
<tr>
<td>3.10. surgical fixation of bone or joint</td>
<td></td>
<td>myel/o</td>
</tr>
</tbody>
</table>
Matching Word Parts 3

Write the correct answer in the middle column.

<table>
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<tr>
<th>Definition</th>
<th>Correct Answer</th>
<th>Possible Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.11. vertebra, vertebrae</td>
<td></td>
<td>oste/o</td>
</tr>
<tr>
<td>3.12. curved</td>
<td></td>
<td>spondyl/o</td>
</tr>
<tr>
<td>3.13. bent backward</td>
<td></td>
<td>lord/o</td>
</tr>
<tr>
<td>3.14. synovial membrane</td>
<td></td>
<td>synovi/o, synov/o</td>
</tr>
<tr>
<td>3.15. bone</td>
<td></td>
<td>scoli/o</td>
</tr>
</tbody>
</table>

Definitions

Select the correct answer and write it on the line provided.

3.16. The shaft of a long bone is known as the ____________________.
      diaphysis           distal epiphysis           endosteum           proximal epiphysis

3.17. The ankles are made up of the ____________________.
      carpals               metatarsals            phalanges            tarsals

3.18. The upper portion of the sternum is the ____________________.
      clavicle               mandible              manubrium            xiphoid process

3.19. The ____________________ joints are movable.
      cartilaginous          fibrous               suture               synovial

3.20. The ____________________ is the anterior portion of the pelvic girdle.
      ilium                  ischium               pubis                sacrum

3.21. The opening in a bone through which the blood vessels, nerves, and ligaments pass is a
      ____________________.
      foramen                 process               suture               symphysis

3.22. The tissue that connects one bone to another bone is known as a/an ____________________.
      articular cartilage     ligament              synovial membrane    tendon

3.23. The hip socket is known as the ____________________.
      acetabulum              malleolus              patella              trochanter
3.24. The __________________________ are the bones of the fingers and toes.

   carpals    metatarsals    tarsals    phalanges

3.25. A normal projection on the surface of a bone is a/an __________________________.

   cruciate    exostosis    popliteal    process

---

**Matching Structures**

Write the correct answer in the middle column.

<table>
<thead>
<tr>
<th>Definition</th>
<th>Correct Answer</th>
<th>Possible Answers</th>
</tr>
</thead>
<tbody>
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<td>3.26. breastbone</td>
<td></td>
<td>clavicle</td>
</tr>
<tr>
<td>3.27. cheek bones</td>
<td></td>
<td>olecranon</td>
</tr>
<tr>
<td>3.28. collar bone</td>
<td></td>
<td>sternum</td>
</tr>
<tr>
<td>3.29. kneecap</td>
<td></td>
<td>patella</td>
</tr>
<tr>
<td>3.30. point of the elbow</td>
<td></td>
<td>zygomatic</td>
</tr>
</tbody>
</table>

---

**Which Word?**

Select the correct answer and write it on the line provided.

3.31. The surgical procedure to loosen an ankylosed joint is called __________________________.

   arthrodesis    arthrolysis

3.32. A physician who specializes in the diagnosis and treatment of diseases characterized by inflammation in the connective tissues is a/an __________________________.

   orthopedist    rheumatologist

3.33. An __________________________ transplant uses bone marrow from a donor.

   allogenic    autologous

3.34. A percutaneous __________________________ is performed to treat osteoporosis related compression fractures.

   diskecctomy    vertebroplasty

3.35. The type of arthritis that is commonly known as wear-and-tear arthritis is __________________________.

   osteoarthritis    rheumatoid arthritis
● **Spelling Counts**

Find the misspelled word in each sentence. Then write that word, spelled correctly, on the line provided.

3.36. The medical term for the condition commonly known as low back pain is lumbaego. ________________

3.37. The surgical fracture of a bone to correct a deformity is known as osteclasis. ________________

3.38. Ankylosing spondilitis is a form of rheumatoid arthritis characterized by progressive stiffening of the spine. ________________

3.39. An osterraphy is the surgical suturing, or wiring together, of bones. ________________

3.40. Crepetation is the sound that is heard when the ends of a broken bone move together. ________________

● **Spelling Out Abbreviations**

Write the correct answer on the line provided.

3.41. BMT ________________

3.42. Fx ________________

3.43. NSAID ________________

3.44. ORIF ________________

3.45. RA ________________

● **Term Selection**

Select the correct answer and write it on the line provided.

3.46. The term meaning the death of bone tissue is ________________.

   osteitis deformans  osteomyelitis  osteonecrosis  osteoporosis

3.47. An abnormal increase in the forward curvature of the lower or lumbar spine is known as ________________.

   kyphosis  lordosis  scoliosis  spondylosis
3.48. The condition known as _________________ is a congenital defect.

juvenile arthritis    osteoarthritis    rheumatoid arthritis    spina bifida

3.49. A malignant tumor composed of cells derived from blood-forming tissues of the bone marrow is known as a/an ____________________ .

chondroma    Ewing's sarcoma    myeloma    osteochondroma

3.50. The bulging deposit that forms around the area of the break during the healing of a fractured bone is a ____________________ .

callus    crepitation    crepitus    luxation

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**Sentence Completion**

Write the correct term on the line provided.

3.51. A/An ____________________ is performed to treat a patient with craniostenosis.

3.52. The partial displacement of a bone from its joint is known as ____________________ .

3.53. The procedure, also known as fusion, that stiffens a joint or joins several vertebrae is a/an ____________________ .

3.54. The surgical procedure to replace a joint with an artificial joint is known as ____________________ .

3.55. A medical term for the condition commonly known as a bunion is ____________________ .

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**Word Surgery**

Divide each term into its component word parts. Write these word parts, in sequence, on the lines provided.

When necessary use a back slash (/) to indicate a combining vowel. (You may not need all of the lines provided.)

3.56. A **bursectomy** is the surgical removal of a bursa.

____________  ____________  ____________  ____________

3.57. An **osteochondroma** is the most common benign bone tumor.

____________  ____________  ____________  ____________

3.58. **Osteomalacia**, also known as adult rickets, is abnormal softening of bones in adults.

____________  ____________  ____________  ____________
3.59. **Periostitis** is an inflammation of the periosteum.

3.60. **Spondylolisthesis** is the forward movement of the body of one of the lower lumbar vertebra on the vertebra below it.

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**True/False**

If the statement is true, write **T** on the line. If the statement is false, write **F** on the line.

3.61. ____ Osteopenia is thinner than average bone density in a young person.

3.62. ____ Paget's disease is caused by a deficiency of calcium and vitamin D in early childhood.

3.63. ____ A thermal capsulorrhaphy uses heat to shrink and tighten tissues involved in shoulder instability disorders such as dislocation.

3.64. ____ Luxation is the partial displacement of a bone from its joint.

3.65. ____ Arthroscopic surgery is a minimally invasive procedure for the treatment of the interior of a joint.

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**Clinical Conditions**

Write the correct answer on the line provided.

3.66. When Bobby Kuhn fell out of a tree, the bone in his arm was partially bent and partially broken. Dr. Parker described this as ________________ fracture and told the family that this type of fracture occurs primarily in children.

3.67. Eduardo Sanchez has an inflammation of the bone and bone marrow. The medical term for this condition is ________________.

3.68. Brent Hargraves, who is 16, was diagnosed as having ________________ sarcoma. This is a group of cancers that most frequently affect children or adolescents.

3.69. Mrs. Morton suffers from dowager's hump. The medical term for this abnormal curvature of the spine is ________________.

3.70. Henry Turner specializes in creating ________________. These are orthopedic appliances to align, prevent, or correct deformities or to improve the function of movable parts of the body.
3.71. After an auto accident, Tiffany required a/an ____________________ to relieve the intracranial pressure on her brain.

3.72. Mrs. Gilmer’s leukemia is being treated with a bone marrow transplant. Some of her bone marrow was harvested so that she will be able to receive a/an ____________________ bone marrow transplant.

3.73. Betty Greene has been running for several years; however, now her knees hurt. Dr. Baskin diagnosed her condition as ____________________, which is an abnormal softening of the cartilage in these joints.

3.74. Patty Turner (age 7) has symptoms that include a skin rash, fever, slowed growth, fatigue, and swelling in the joints. She was diagnosed as having juvenile ____________________ arthritis.

3.75. Robert Young has a very sore shoulder. Dr. Wilson diagnosed it as an inflammation of the bursa and called it ____________________.

● Which Is the Correct Medical Term?

Select the correct answer and write it on the line provided.

3.76. Rodney Horner is being treated for a ____________________ fracture, in which the ends of the bones were crushed together.

- Colles’
- comminuted
- compound
- spiral

3.77. Alex Jordan’s doctor performed a/an ____________________ to surgically repair the cartilage that Alex damaged when she fell.

- arthroplasty
- chondritis
- chondroplasty
- osteoplasty

3.78. Jane Parker is at high risk for osteoporosis. To obtain a definitive evaluation of her condition, Jane’s doctor ordered a/an ____________________ test.

- blood calcium
- DXA
- MRI
- ultrasonic bone density testing

3.79. In an effort to return a fractured bone to normal alignment, Dr. Wong ordered ____________________. This procedure exerts a pulling force on the distal end of the affected limb.

- external fixation
- immobilization
- internal fixation
- traction

3.80. Baby Juanita was treated for a congenital deformity in which her foot turned inward. Her family called this clubfoot; however the medical term for this condition is ____________________.

- hallux valgus
- rickets
- scoliosis
- talipes
Challenge Word Building

These terms are not found in this chapter; however, they are made up of the following familiar word parts. You may want to look in the textbook glossary or use a medical dictionary to check your answers.

- poly-  - arthr/o  - -ectomy
- chondr/o  - -itis
- cost/o  - -malacia
- crani/o  - -otmy
- oste/o  - -pathy
- -sclerosis

3.81. Abnormal hardening of bone is called _______________________.

3.82. The surgical removal of a rib is a/an _______________________.

3.83. The term meaning a disease of the cartilage is _______________________.

3.84. A surgical incision into a joint is a/an _______________________.

3.85. The term meaning inflammation of cartilage is _______________________.

3.86. The surgical removal of a joint is a/an _______________________.

3.87. The term meaning inflammation of more than one joint is _______________________.

3.88. The term meaning any disease involving the bones and joints is _______________________.

3.89. A surgical incision or division of a rib is a/an _______________________.

3.90. The term meaning abnormal softening of the skull is _______________________.
Labeling Exercises

Identify the numbered items on the accompanying figures.

3.91. ___________________ vertebrae
3.92. ___________________
3.93. ___________________
3.94. ___________________
3.95. ___________________
3.96. ___________________
3.97. ___________________
3.98. ___________________
3.99. ___________________
3.100. ___________________
THE HUMAN TOUCH: CRITICAL THINKING EXERCISE

The following story and questions are designed to stimulate critical thinking through class discussion or as a brief essay response. There are no right or wrong answers to these questions.

*Dr. Johnstone didn’t like what he saw. The x-rays of Gladys Gwynn’s hip showed a fracture of the femoral neck and severe osteoporosis of the hip. Mrs. Gwynn had been admitted to the orthopedic ward of Hamilton Hospital after a fall that morning at Sunny Meadows, an assisted-living facility. The accident had occurred when Sheri Smith, a new aide, lost her grip while helping Mrs. Gwynn in the shower.*

A frail but alert and cheerful woman of 85, Gladys Gwynn has osteoarthritis and osteoporosis that have forced her to rely on a walker. She has been living at Sunny Meadows since her husband’s death four years ago. *Dr. Johnstone knew that she didn’t have any relatives in the area, and he did not think that she had signed a health care power of attorney designating someone to help with medical decisions like this.*

*A total hip replacement (THP) would be the logical treatment for a younger patient because it could restore some of her lost mobility. However, for a frail patient like Mrs. Gwynn, internal fixation of the fracture might be the treatment of choice. This would repair the break but not improve her mobility.*

*Dr. Johnstone needed to make a decision soon, but Mrs. Gwynn was still groggy from the pain medication. With one more look at the x-ray, Dr. Johnstone sighed and walked toward Mrs. Gwynn’s room.*

**Suggested Discussion Topics:**

1. Gladys Gwynn has no children or other relatives in the area and is unable to speak for herself. Who should decide which surgery should be performed?
2. Do you think Sheri Smith or Sunny Meadows should be held responsible for Mrs. Gwynn’s accident? If so, who should be held responsible?
3. A total hip replacement is more expensive than the internal fixation procedure and has a longer, more strenuous recovery period. Given the patient’s condition and the limited dollars available for health care, which procedure should be performed?
4. Would you have answered Question 3 differently if Mrs. Gwynn were your mother?
5. If Mrs. Gwynn’s recovery does not go well and she is no longer able to get around by herself, will she be allowed to continue living at Sunny Meadows?