

Chapter 6: Bones and Skeletal Tissues

- 6.1 Hyaline, elastic, and fibrocartilage help form the skeleton
 - 6.2 Bones perform several important functions
 - 6.3 Bones are classified by their location and shape
 - 6.4 All bones consist of outer compact bone and inner spongy bone
 - 6.5 Bones develop either by intramembranous or endochondral ossification
 - 6.6 Bone remodeling involves bone deposition and removal
 - 6.7 Bone repair involves hematoma and callus formation, and remodeling
 - 6.8 Bone disorders result from abnormal bone deposition and resorption
-

Chapter 6.1: Hyaline, elastic, and fibrocartilage help form the skeleton

LO 6.1a: Describe the functional properties of the three types of cartilage tissue.

1. Assign each variety of cartilage (hyaline cartilage, elastic cartilage, and fibrocartilage) to the description of its function.

_____ Maintains the shape of a structure while allowing great flexibility.

_____ Resists compression and provides great tensile strength.

_____ Provides support with flexibility and resilience.

LO 6.1b: Locate the major cartilages of the adult skeleton.

2. Complete the table by assigning each variety of cartilage (hyaline cartilage, elastic cartilage, and fibrocartilage) to its location in the body. Refer to **Figure 6.1** for help.

Type of cartilage	Location in the body
	Covers the ends of most bones at movable joints
	The cartilage of the external ear
	The cartilages that support the external nose
	Disc of cartilage that joins the hip bones anteriorly
	Costal cartilage that connects a rib to the sternum (breastbone)
	Padlike cartilages (menisci) of the knee joint
	Forms the epiglottis (the flap that bends to cover the larynx)
	Cartilage that reinforces the walls of the trachea

LO 6.1c: Explain how cartilage grows.

3. Fill in the blanks.

In _____ (appositional or interstitial) growth, new cartilage grows from within existing cartilage tissue.

In _____ (appositional or interstitial) growth, new cartilage tissue is added at the periphery of existing cartilage tissue.

4. Write T in the answer blank if the statement below is true. If false, correct the underlined word by writing the correct word in the blank.

_____ (True or False) The hard extracellular matrix of cartilage tissue allows for mitosis.

Chapter 6.2: Bones perform several important functions

LO 6.2: Describe the functions of the skeleton and of bone tissue.

1. Briefly describe in the table below how our bones perform each of the following functions.

Function	Description
Support	
Protection	
Anchorage	
Mineral storage	
Blood cell formation	
Triglyceride (fat) storage	
Hormone production	

Chapter 6.3: Bones are classified by their location and shape

LO 6.3a: Name the major regions of the skeleton and describe their relative functions.

1. Fill in the blanks.

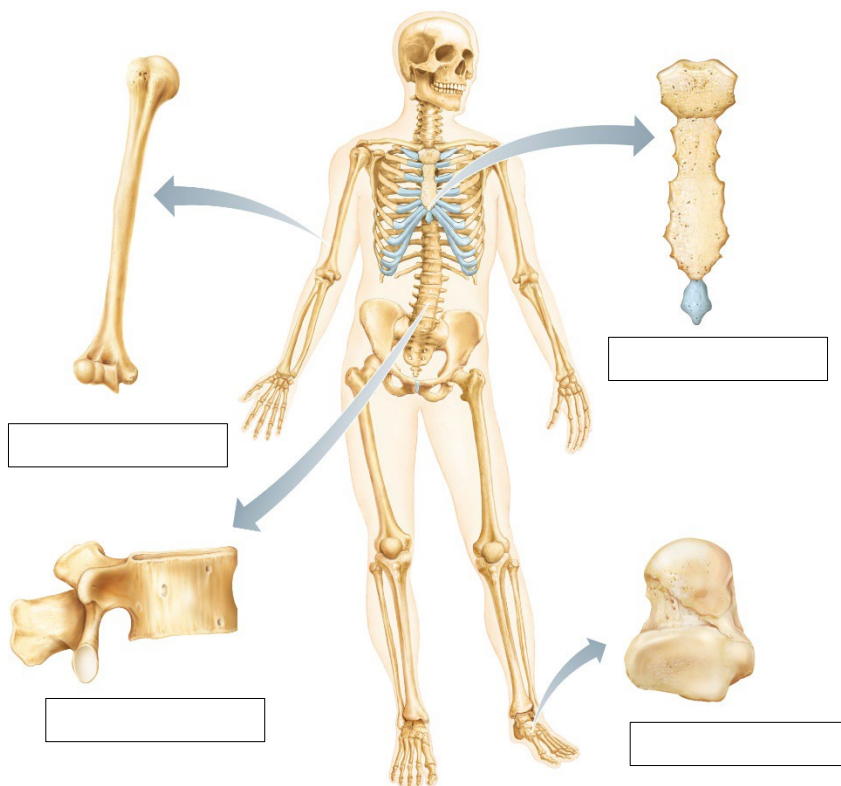
The _____ (axial or appendicular) skeleton consists of the bones of the upper and lower limbs and the girdles that attach the limbs to the trunk.

The _____ (axial or appendicular) skeleton includes bones of the skull, vertebral column, and rib cage.

2. Differentiate between the general functions of the axial and appendicular regions of the skeleton.

LO 6.3b: Compare and contrast the four bone classes and provide examples of each class.

3. Classify each of the bones shown in the figure on the basis of their shape. Refer to **Figure 6.2** for help.



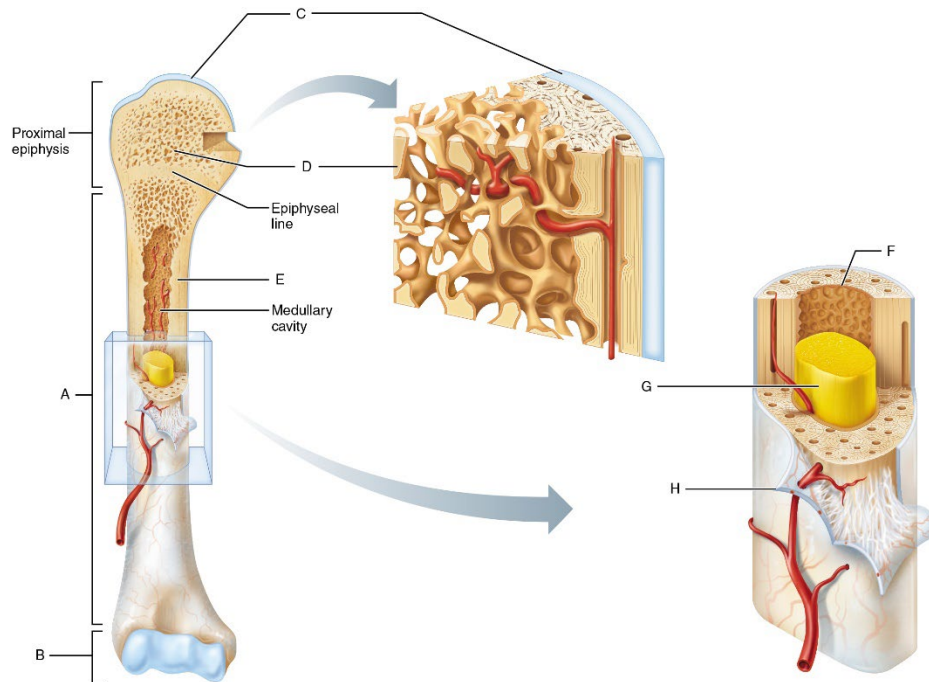
4. What bone class do most of the limb bones fall into?

Chapter 6.4: All bones consist of outer compact bone and inner spongy bone

LO 6.4a: Describe the gross anatomy of a typical flat bone and a long bone. Indicate the locations and functions of red and yellow bone marrow, articular cartilage, periosteum, and endosteum.

1. Indicate the location of the following structures by assigning the letters (A–H) from the figure.

- | | | |
|-----------------|----------------------|-------------------------|
| ___ Endosteum | ___ Distal epiphysis | ___ Articular cartilage |
| ___ Spongy bone | ___ Compact bone | ___ Yellow bone marrow |
| ___ Periosteum | ___ Diaphysis | |



2. What is the function of red bone marrow? List several locations where red bone marrow is located in an adult skeleton.

3. Briefly describe how the gross anatomy of a typical flat bone differs from that of a long bone.

LO 6.4b: Indicate the functional importance of bone markings.

4. Table 6.2 describes important bone markings that you will come across when studying the detailed structure of individual bones in Chapter 7. For each of the bone markings listed below, place an (X) on the category to which it belongs.

Bone Marking	Projections that are	Surfaces that help to	Depressions and
Meatus			
Condyle			
Tubercle			
Foramen			
Spine			
Trochanter			
Facet			
Fossa			
Epicondyle			
Tuberosity			
Head			

LO 6.4c: Describe the histology of compact and spongy bone.

5. For each of the following structures, determine whether they are a part of compact bone only, spongy bone only, or both compact bone and spongy bone.

Osteons _____

Trabeculae _____

Osteocytes _____

Canaliculi _____

6. Assign the structures (a–f) and cell types (g–i) to their descriptions.

- | | | |
|-------------------|------------------------|----------------|
| a. Central canals | d. Trabeculae | g. Osteocytes |
| b. Canaliculi | e. Concentric lamellae | h. Osteoblasts |
| c. Lacunae | f. Perforating canals | i. Osteoclasts |

- _____ Chambers that contain mature bone cells
- _____ Small needle-like or flat pieces of bone that form a honeycomb structure
- _____ Cells that resorb (break down) bone
- _____ Tiny canals filled with tissue fluid and containing extensions of bone cells
- _____ Layers of bone matrix in compact bone
- _____ Canals that lie at right angles to the long axis of a long bone
- _____ Mature bone cells that monitor and maintain bone matrix
- _____ Canals that run through the core of each osteon
- _____ Bone-forming cells that secrete the bone matrix

LO 6.4d: Discuss the chemical composition of bone and the advantages conferred by its organic and inorganic components.

7. The chemical composition of bone can be compared to a highway. In highway construction, concrete is poured over iron reinforcing bars (called “rebar”). The concrete allows the road to resist compression and the rebar reinforces the concrete by adding tensile strength and a tiny bit of flexibility.

Let’s apply this analogy to the chemical composition of bone.

List the organic components of bone.

What characteristics of bone are due to these organic components? In the analogy, are the organic components more like the concrete of the highway or the rebar?

List the inorganic components of bone.

What characteristics of bone are due to these inorganic components? In the analogy, are the inorganic components more like the concrete of the highway or the rebar?

Chapter 6.5: Bones develop either by intramembranous or endochondral ossification

LO 6.5a: Compare and contrast intramembranous ossification and endochondral ossification.

1. Order the following events of endochondral ossification by assigning each a number (1–5). Refer to **Figure 6.9** for help.

_____ Secondary ossification centers appear in the epiphyses; a medullary cavity forms in the diaphysis.

_____ The periosteal bud invades the internal cavities and spongy bone forms.

_____ A bone collar forms around the diaphysis of the hyaline cartilage model.

_____ The epiphyses ossify.

_____ Cartilage calcifies in the center of the diaphysis and then develops cavities.

2. Which of the following bones forms by intramembranous ossification? _____

(a) Frontal bone of the cranium

(b) Radius of the forearm

(c) Vertebra of the spine

(d) Carpal of the carpus (wrist)

3. For each statement that is true, write T in the answer blank. For false statements, correct the underlined word by writing the correct word in the blank.

_____ In endochondral ossification, a bone develops from a fibrous membrane.

_____ Endochondral ossification is more complex than intramembranous ossification.

_____ Most bones that form by intramembranous ossification are flat bones.

_____ In intramembranous ossification, compact bone forms first.

LO 6.5b: Describe how epiphyseal plates allow long bones to grow.

4. Fill in the blanks.

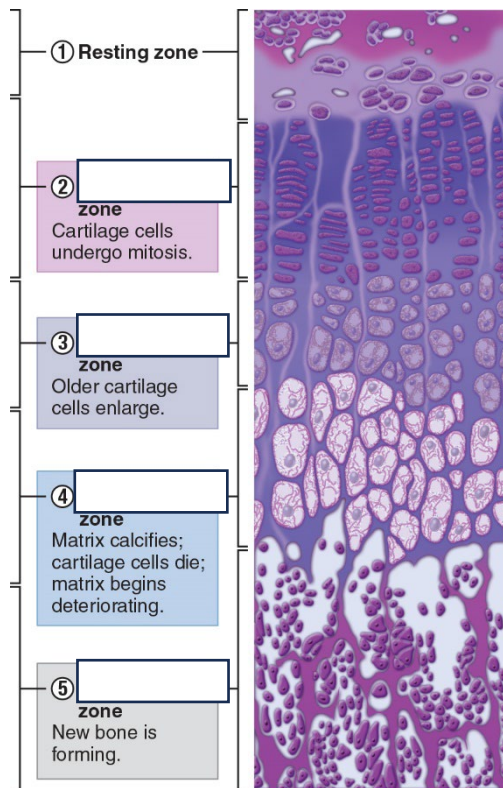
Growth in _____ (length or width) of a long bone occurs at the epiphyseal plate.

The epiphyseal plate maintains a constant thickness because the rate of cartilage growth on its _____ (epiphysis or diaphysis)-facing side is balanced by its replacement with bony tissue on its _____ (epiphysis or diaphysis)-facing side.

Growth in width (thickness) occurs by _____ growth.

5. Assign each of the zones of an epiphyseal plate to their correct locations. Refer to **Figure 6.11** for help.

- (A) Calcification zone
- (B) Ossification zone
- (C) Proliferation zone
- (D) Hypertrophic zone



6. Achondroplasia is a form of dwarfism. If we break the term “achondroplasia” down into three parts, it literally describes what it means.

Go to the “Word Roots, Prefixes, Suffixes, and Combining Forms” section at the end of the book and break down the parts of this term to better understand this condition.

The prefix “A-” means _____

The prefix “Chondr-” means _____

The suffix “Plas-” means _____

Putting these three parts together, what does achondroplasia literally translate to?

In individuals with achondroplasia, the epiphyseal plates of long bones are much thinner than is typical. From the figure in Question 5, which two zones of the epiphyseal plate do you think are most likely responsible for producing a thinner epiphyseal plate?

Chapter 6.6: Bone remodeling involves bone deposition and removal

LO 6.6a: Compare the locations and remodeling functions of the osteoblasts, osteocytes, and osteoclasts.

1. In the adult skeleton, where does bone remodeling primarily occur? ____
 - (a) Endosteum
 - (b) Epiphyseal plate
 - (c) Periosteum
 - (d) Articular cartilage
 2. If osteoclasts are more active than osteoblasts in the femur, how will the bone mass of the femur change? ____
 - (a) Bone mass will increase.
 - (b) Bone mass will decrease.
 - (c) Bone mass will not change.
 3. What would happen to bone tissue in the absence of bone remodeling?
-

LO 6.6b: Explain how hormones and physical stress regulate bone remodeling.

4. Why is it important to maintain homeostatic levels of calcium in the extracellular fluid?

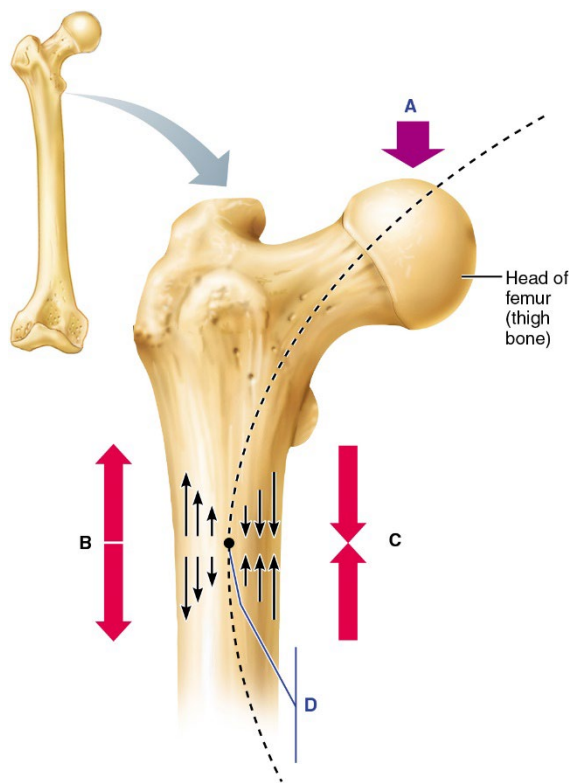
5. The figure below shows mechanical stress being applied to the femur. Assign letters A–D to each of the following conditions represented by the arrows. Refer to **Figure 6.14** for help.

___ Site of maximal compression

___ Load (body weight) application site

___ Point of no stress

___ Site of maximal tension



6. Fill in the blanks.

In response to _____ (low or high) blood calcium levels, the parathyroid glands release _____. This hormone stimulates _____ (type of bone cell) to resorb bone. Bone resorption _____ (increases or decreases) blood calcium levels.

This control system for calcium homeostasis is an example of _____ (negative or positive) feedback because the response of the target cells _____ (reverses or enhances) the effect of the original stimulus.

7. Which hormone is most important in regulating blood calcium levels? _____
- (a) Calcitonin
 - (b) Calcitriol
 - (c) Osteoprotegerin
 - (d) Parathyroid hormone
8. Which hormone lowers blood calcium levels briefly when administered at pharmacological (abnormally high) doses? _____
- (a) Calcitonin
 - (b) Calcitriol
 - (c) Osteoprotegerin
 - (d) Parathyroid hormone

Chapter 6.7: Bone repair involves hematoma and callus formation, and remodeling

LO 6.7: Describe the steps of fracture repair.

1. What is the correct order of stages in the healing of a closed fracture? Refer to [Figure 6.15](#) for help. _____
- (a) (1) Fibrocartilaginous callus forms; (2) bony callus forms; (3) hematoma forms; (4) bone remodeling occurs
 - (b) (1) Hematoma forms; (2) fibrocartilaginous callus forms; (3) bony callus forms; (4) bone remodeling occurs
 - (c) (1) Fibrocartilaginous callus forms; (2) hematoma forms; (3) bone remodeling occurs; (4) bony callus forms
 - (d) (1) Hematoma forms; (2) bone remodeling occurs; (3) fibrocartilaginous callus forms; (4) bony callus forms
2. For each statement that is true, write T in the answer blank. For false statements, correct the underlined word by writing the correct word in the blank.

_____ In displaced fractures, the bone ends are out of normal alignment.

_____ In complete fractures, the bone is broken through.

_____ In open fractures, the bone ends penetrate the skin.

_____ Closed fractures are also called compound fractures.

3. Assign each type of fracture to its description. Refer to **Table 6.3** for help.

- | | |
|--------------------------|-------------------------|
| (a) Spiral fracture | (d) Greenstick fracture |
| (b) Compression fracture | (e) Comminuted fracture |
| (c) Depressed fracture | (f) Epiphyseal fracture |

- _____ Bone is crushed; common in the vertebral column
- _____ Broken bone portion is pressed inward; typical of a skull fracture
- _____ Bone breaks incompletely; common in children
- _____ Bone fragments into three or more pieces; more common in older adults
- _____ Bone breaks due to excessive twisting forces; common sports fracture
- _____ End of a long bone separates from the shaft; tends to occur where cartilage cells are dying and calcification of the matrix is occurring

Chapter 6.8: Bone disorders result from abnormal bone deposition and resorption

LO 6.8: Contrast the disorders of bone remodeling seen in osteoporosis, osteomalacia, rickets, and Paget’s disease.

1. Complete the table by assigning each bone disorder listed below with its descriptive phrases.

Osteoporosis Rickets Paget’s disease Osteomalacia

Bone disorder	Descriptive phrases
	Bone resorption outpaces bone deposit resulting in decreased bone density throughout the skeleton; more common in postmenopausal females.
	Excessive and abnormal bone deposit and resorption results in bone with an abnormally high ratio of spongy bone to compact bone; usually a localized condition.
	Bones are soft and weak; disorder in children in which bowed legs and deformities of the pelvis, skull, and rib cage are common.
	Bones are poorly mineralized; caused by insufficient calcium in the diet or by a vitamin D deficiency.