

Skeletal System

I. Bone Structure

A. Bone Classification

1. The four classes of bone according to shape are _____

2. Examples of long bones are _____

3. Short bones are shaped like _____
4. Examples of short bones are _____
5. Flat bones are _____ structures.
6. Examples of flat bones are _____
7. Irregular bones have a variety of _____
8. Examples of irregular bones are _____
9. Round bones are also called _____
10. Sesamoid bones are _____ and _____ and embedded in _____
11. An example of a sesamoid bone is the _____

B. Parts of a Long Bone

1. An expanded end of a long bone is an _____
2. An epiphysis articulates with _____
3. Articular cartilage is located _____
4. The shaft of a long bone is called a _____
5. Periosteum is _____
6. Periosteum functions to _____
7. Processes provide sites for _____
8. The wall of the diaphysis is composed of _____ bone.
9. Compact bone has _____
10. The epiphyses are largely composed of _____ bone.
11. Spongy bone consists of bony plates called _____
12. A bone usually has both _____
13. A canal called _____ runs through the diaphysis.

14. Endosteum lines _____
15. Endosteum contains _____ cells.
16. The tissue that fills the spaces of bone is called _____
17. The two forms of marrow are _____

C. Microscopic Structure

1. Introduction

- a. Bone cells are called _____
- b. Lacunae are _____
- c. Lacunae form _____
around _____
- d. Osteocytes transport _____
- e. Cellular processes of osteocytes pass through _____
- f. The intercellular matrix of bone is composed of _____

2. Compact Bones

- a. An osteon is _____
- b. The substance of compact bone is formed from _____

- c. Each central canal contains _____
- d. Perforating canals connect _____
- e. Perforating canals contain _____

3. Spongy Bone

- a. Spongy bone is also composed of _____
and _____
- b. Unlike compact bone, the bone cells do not _____

- c. Instead the cells lie within _____
- d. Osteocytes get nutrients from _____

II. Bone Development and Growth

A. Introduction

1. Parts of the skeleton begin to form _____
2. Bony structures continue to grow until _____
3. Bones form by replacing _____
4. Intramembranous bones originate within _____
5. Endochondral bones originate within _____

B. Intramembranous Bones

1. Examples of intramembranous bones are _____
2. Osteogenesis is _____
3. During their development, _____
appear at the sites of their future bones.
4. _____ supply the connective tissue layers.
5. Osteoblasts are _____
6. Osteoblasts deposit _____
7. Spongy bone can become _____
8. As development continues, osteoblasts may become surrounded by _____

9. Matrix surrounding the processes of osteoblasts give rise to _____

10. Once isolated, osteoblasts become _____
11. Periosteum comes from _____
12. Compact bone is formed by _____
13. Intramembranous ossification is _____

C. Endochondral Bones

1. Most of the bones of the skeleton are _____
2. Endochondral bones develop as _____
3. Eventually the cartilage _____
4. As the cartilage decomposes, _____ forms from _____

5. _____ invade the disintegrating tissue.
6. Some of the cells differentiate into _____
7. Osteoblasts form _____

8. Endochondral ossification is _____
9. The primary ossification center is _____
10. Secondary ossification centers appear _____
11. The epiphyseal plate is _____

D. Growth at the Epiphyseal Plate

1. In a long bone, the diaphysis is separated from the epiphysis by _____

2. The cartilaginous cells occur in _____ layers.
3. The first layer is composed of _____
4. The first layer anchors _____
5. The second layer contains _____
6. As new cells appear, the cartilaginous plate _____
7. The third layer is formed by _____
8. The cells of the third layer _____ the epiphyseal plate.
9. The fourth layer is composed of _____
10. Osteoclasts break down _____
11. Osteoclasts originate from _____
12. Osteoclasts secrete _____
13. Osteoclasts phagocytize _____
14. After osteoclasts remove the matrix, _____ invade the region and

15. A long bone continues to lengthen while _____
16. Lengthening of the bone is no longer possible when _____

17. The medullary cavity forms when _____
18. The bone in the _____ remains spongy.
19. Hyaline cartilage on the ends persists as _____

E. Homeostasis of Bone Tissue

1. Throughout life, osteoclasts _____
and osteoblasts _____
2. About _____ of bone calcium is exchanged each year.

F. Factors Affecting Bone Development, Growth, and Repair

1. Factors that affect bone development, growth and repair include _____

2. Vitamin D is necessary for _____
3. Lack of vitamin D can lead to the diseases _____
4. Vitamin A is necessary for _____
5. Vitamin C is required for _____
6. Growth hormone stimulates _____
7. In children, the absence of growth hormone leads to _____
8. An excess of growth hormone before the epiphyseal plates ossify leads to _____

9. In adults, an excess of growth hormone leads to _____
10. Thyroid hormone can halt _____ by causing _____
11. Deficiency of thyroid hormone may stunt _____
12. Parathyroid hormone stimulates _____
13. Androgens are _____
14. Androgens promote _____
15. Sex hormones also stimulate _____
16. Females typically reach their maximum heights earlier than males because _____

17. Physical stress stimulates _____

III. Bone Function

A. Support and Protection

1. Bones give shape to _____
2. The bones of _____ support the body's weight.
3. The bones of the skull protect _____
4. The bones of the _____ protect the heart and lungs.

5. Bones of the pelvic girdle protect _____

B. Body Movement

1. Bones and muscles interact as _____

2. The four basic components of a lever system are _____

3. In scissors, the _____ form a rigid bar.

4. The pivot of scissors is _____

5. The resistance of scissors is _____

6. The force of scissors is supplied by _____

7. In a first class lever system, the parts are arranged _____

8. Besides scissors, other examples of first class lever systems are _____

9. In a second class lever system, the parts are arranged _____

10. An example of a second class lever system is _____

11. In a third class lever system, the parts are arranged _____

12. An example of a third class lever system is _____

13. In the action of bending the upper limb at the elbow, the rigid bar is _____ ,
the pivot is _____ , the resistance is _____ ,
and the force is applied by _____

14. Bending the arm at the elbow is an example of a _____
class lever system.

15. When the upper limb straightens at the elbow, the rigid bar is _____ ,
the pivot is _____ , the resistance is _____ ,
and the force is applied by _____

16. Straightening the arm at the elbow is a first class lever system because _____

17. An example of a second class lever system in the body is _____

C. Blood Cell Formation

1. Hematopoiesis is _____
2. Blood cell formation begins _____
3. Later in development, blood cells are made _____

4. Marrow is _____ within _____

5. Red marrow functions in _____
6. Red marrow occupies _____
7. With increasing age, _____ replaces red marrow.
8. Yellow marrow stores _____
9. In an adult, red marrow is primarily found _____

D. Inorganic Salt Storage

1. Intercellular matrix of bone tissue contains _____

2. The salts account for _____ by weight.
3. Hydroxyapatites are _____
4. The body requires calcium for _____

5. When blood calcium is _____, parathyroid hormone stimulates _____

6. Very high blood calcium levels inhibit _____
7. Calcitonin stimulates _____
8. Bone tissue contains lesser amounts of _____

IV. Skeletal Organization

A. Number of Bones

1. The number of bones in a human skeleton is around _____
2. Flat bones of the skull are tightly joined by _____

B. Divisions of the Skeleton

1. Two major portions of the skeleton are _____
2. The axial skeleton contains _____
3. The skull is composed of _____
4. The hyoid bone supports _____
5. The hyoid bone is located _____
6. The vertebral column consists of _____
7. The distal end of the column is formed by the _____
and the _____
8. The coccyx is also called the _____
9. The thoracic cage is composed of _____

10. The appendicular skeleton consists of _____

11. The pectoral girdle is formed by _____
12. The pectoral girdle connects _____
13. The pectoral girdle aids in _____
14. Each upper limb consists of _____

15. The humerus, radius, and ulna articulate _____
16. The wrist bones are called _____
17. The bones of the palm are called _____
18. Bones in the fingers are called _____
19. The pelvic girdle is formed by _____
20. The pelvic girdle connects _____
21. The pelvic girdle, sacrum, and coccyx form the _____
22. Each lower limb consists of _____
23. The femur and tibia articulate with each other at _____
24. The kneecap is called the _____
25. The ankle bones are _____
26. The bones of the instep of the foot are called _____

27. Bones of the toes are called _____

V. Skull

A. Introduction

1. A human skull usually consists of _____
2. The moveable bone in the skull is the _____
3. Some cranial and skull bones together form the _____ of the eye.

B. Cranium

1. The cranium encloses and protects _____
2. The surface of the cranium provides attachments for _____

3. Sinuses are _____
4. Sinuses reduce _____
and increase _____
5. The eight bones of the cranium are _____

6. The frontal bone forms _____

7. The supraorbital foramen is _____ and allows
_____ to pass to tissues of the head.
8. The sinuses of the frontal bone are called _____
9. The two halves of the frontal bone fuse together by _____

10. One parietal bone is located _____
11. Together the parietal bones form _____
12. The sagittal suture fuses _____
13. The coronal suture fuses _____
14. The occipital bone joins the parietal bones along the _____
15. The occipital bone forms the _____
16. The foramen magnum is _____
17. Occipital condyles are located _____
18. Occipital condyles articulate with _____

19. A temporal bone on each side of the skull joins the parietal bone along a _____

20. The temporal bones form _____
21. The opening leading inward to parts of the ear is called _____

22. Mandibular fossae articulate with _____
23. The mastoid process is a site of attachment for _____
24. The styloid process is a site of attachment for _____
25. The carotid canal is near the _____
and transmits _____
26. The jugular foramen is _____ and accommodates the

27. The zygomatic process projects _____
and joins the _____
28. The sphenoid bone helps form the _____

29. The sella turcica is _____
and holds the _____
30. The sinuses of the sphenoid bone are called _____
31. The ethmoid bone is located _____
32. It consists of two masses joined by _____
33. The cribriform plates form _____
34. _____ pass through olfactory foramina.
35. Portions of the ethmoid bone also form _____

36. A _____ projects downward from the
_____ to form most of the nasal septum.
37. Scroll-shaped plates called _____ project inward from the
lateral portions of the ethmoid bone.
38. The lateral portions of the ethmoid bone contain many small air spaces called

39. The crista galli is _____
40. The crista galli is attached to membranes that _____

C. Facial Skeleton

1. The facial skeleton consists of _____ immovable bones and a movable _____
2. The facial bones provide sites of attachment for _____
3. The _____ forms the upper jaw.
4. Portions of the maxillary bones also comprise _____
5. The maxillary bones also contain _____ for the upper teeth.
6. Inside the maxillae, lateral to the nasal cavity are _____
7. The maxillary sinuses extend from _____ to _____
8. During development, portions of the maxillary bones called _____ grow together and form _____
9. The alveolar arch is _____
10. _____ occupy cavities in this arch.
11. The palatine bones are _____ shaped.
12. The palatine bones are located _____
13. The horizontal portions of the palatine bones form _____
14. The perpendicular portions of the palatine bones help form the _____
15. Zygomatic bones are responsible for _____
16. Each zygomatic bone has a _____ process which extends posteriorly to join _____
17. The zygomatic arch is formed by _____
18. Lacrimal bones are located _____
19. The nasal bones form the bridge of _____

20. The nasal bones are attachments for _____
21. The vomer is located _____
22. Posteriorly the vomer joins _____
23. The nasal septum is formed from _____

24. The inferior nasal conchae are attached to _____

25. Like the ethmoidal conchae, the inferior conchae support _____

26. The mandible is shaped like _____
27. The flat projections at the ends of a mandible are _____
28. The rami are divided into _____

29. The mandibular condyles articulate with _____
30. The coronoid processes provide _____
31. The alveolar border is _____
and it contains _____
32. Mandibular foramens are located _____
33. _____ run through mandibular foramens.
The mental foramen is _____

D. Infantile Skull

1. At birth, the skull is _____ developed with _____
_____ connecting the cranial bones.
2. Fontanelles are _____
3. Fontanelles permit _____
4. Eventually fontanelles _____ and cranial bones _____

VI. Vertebral Column

A. Introduction

1. The vertebral column extends from _____ to _____
_____ and forms _____

2. The vertebral column is composed of _____ that are separated by _____
3. The vertebral column supports the _____
4. The vertebral column protects _____
5. The spinal cord passes through _____
6. An infant has _____ separate bones in the vertebral column
7. The sacrum is formed by _____
8. The coccyx is formed by _____
9. An adult vertebral column has _____ bones.
10. The four curvatures of the vertebral column are _____
11. The cervical curvature develops when _____
12. The lumbar curvature develops when _____

B. A Typical Vertebra

1. The body of a vertebra forms _____
2. The intervertebral discs are fastened to _____
3. The discs cushion and soften _____
4. Anterior longitudinal ligaments join _____
5. Posterior longitudinal ligaments join _____
6. Pedicles are _____
7. Laminae are _____
8. A vertebral arch formed by _____
9. Spinous processes are _____
10. A transverse process projects _____
11. Superior and inferior articulating processes project _____
and _____
12. Intervertebral foramina provide passageways for _____

C. Cervical Vertebra

1. There are _____ cervical vertebrae.
2. The transverse processes of cervical vertebrae are distinctive because _____

3. The spinous processes of the second through the sixth cervical vertebrae are ____

4. The vertebra prominens is _____
5. The atlas is _____
6. The atlas supports _____
7. The facets of the atlas articulate with _____
8. The axis is _____
9. The dens is a process that projects _____ and lies in the ring of

10. As the head is turned from side to side, _____ pivots around

D. Thoracic Vertebra

1. There are _____ thoracic vertebrae.
2. The facets of thoracic vertebrae articulate with _____
3. The bodies of thoracic vertebrae are adapted to _____

E. Lumbar Vertebra

1. There are _____ lumbar vertebrae and they are located _____

2. The bodies of lumbar vertebrae are _____ than the superior vertebrae.
3. The transverse processes of lumbar vertebrae project _____
and the spinous processes are _____

F. Sacrum

1. The sacrum is _____ in shape.
2. The median sacral crest is _____
3. Dorsal sacral foramina are _____
4. The sacrum is wedged between _____
and is united to them at its _____

5. The sacrum forms the _____ wall of the pelvis
6. The sacral promontory is _____
7. Anterior sacral foramina provide passageways for _____

G. Coccyx

1. The coccyx is the lowest part of _____
2. Sitting presses on the coccyx, and it moves _____, acting like a _____

VII. Thoracic Cage

A. Introduction

1. The thoracic cage includes _____

2. The thoracic cage supports _____
and protects _____

B. Ribs

1. The usual number of ribs is _____
2. The true ribs are _____
3. The false ribs are _____
4. Floating ribs are _____
5. A typical rib has a long, slender _____
6. The head of a rib is _____
7. The head of a rib articulates with _____

8. A tubercle of a rib articulates with _____
9. Costal cartilages are composed of _____
10. Costal cartilages are attached to the _____ ends of a rib.

C. Sternum

1. The sternum is located _____
2. The three parts of the sternum are _____
3. The _____ process projects downward.
4. The manubrium articulates with _____
5. The manubrium and body articulate with _____

VIII. Pectoral Girdle

A. Introduction

1. The four parts of the pectoral girdle are _____
2. The pectoral girdle supports _____ and is an attachment for _____

B. Clavicles

1. A clavicle has an _____ shape.
2. Clavicles run between _____
3. The medial ends of the clavicles articulate with _____
4. The lateral ends of the clavicles articulate with _____
5. The clavicles brace _____ and are attachment sites for _____

C. Scapulae

1. The scapulae are shaped like _____
2. The spine of a scapula divides _____
3. The acromion process forms _____
4. The coracoid process curves _____
5. The acromion process articulates with _____
6. The glenoid cavity is _____
7. The glenoid cavity articulates with _____
8. The three borders of the scapulae are _____

IX. Upper Limb

A. Introduction

1. The bones of the upper limb form _____
2. The bones of the upper limbs are _____

B. Humerus

1. The humerus extends from _____
2. The head of the humerus fits into _____

3. Two processes just below the head are _____

4. The intertubercular groove is _____
5. The anatomical neck is _____
6. The surgical neck is _____
7. The deltoid tuberosity is _____
8. Two condyles at the lower end of the humerus are _____

9. The capitulum is on the _____ side and articulates with _____

10. The trochlea is on the _____ side and articulates with _____

11. Epicondyles are located _____ and provide attachments for _____
12. The coronoid fossa is _____ that receives _____ when the arm bends at the elbow.
13. The olecranon fossa is _____ that receives _____ when the arm bends at the elbow.

C. Radius

1. The radius is located on the _____ side of the forearm
2. The radius extends from _____ to _____ and crosses over _____ when _____
3. The head of the radius articulates with _____
4. The radial tuberosity is an attachment site for _____
5. The styloid process is located _____

D. Ulna

1. The trochlear notch of the ulna is _____
2. The trochlear notch articulates with _____
3. The olecranon process is located _____
4. The head of the humerus articulates with _____

5. The styloid process of the ulna is located _____

E. Wrist and Hand

1. The wrist is at the junction of _____

2. The bones of the wrist are called _____

3. The individual names of the 8 carpals are _____

4. The anterior surface of the wrist is concave to allow for _____

5. The hand is composed of _____

6. The metacarpals form the framework of _____

7. The distal ends of metacarpals form _____

8. Proximally, the metacarpals articulate with _____

9. Distally, the metacarpals articulate with _____

10. The metacarpal of the thumb is numbered _____

11. The finger bones are _____

12. Each finger has _____ phalanges and the thumb has _____ phalanges.

X. Pelvic Girdle

A. Introduction

1. The pelvic girdle consists of _____

2. The pelvis is formed by _____

3. The pelvic girdle supports _____

4. The pelvic girdle provides attachments for _____
and protects _____

5. The body's weight is transmitted through the pelvic girdle to _____
and then onto _____

B. Coxae

1. A coxa is also called a _____

2. Each coxa develops from the following three parts _____

3. The acetabulum is _____

4. The acetabulum receives _____
5. The _____ is the largest and most superior portion of the coxa.
6. The ilium forms the prominence of _____
7. The iliac crest is _____
8. The iliac fossa is _____
9. Posteriorly the joins the sacrum at _____
10. The anterior superior iliac spine can be felt _____
and is an important _____ landmark.
11. On the posterior border of the ilium is a _____
12. Below the posterior superior iliac spine is a deep indentation called _____
_____, through which _____
_____ pass.
13. The lowest portion of the coxa is _____
14. The ischium is _____ shaped.
15. The ischial tuberosity points _____
16. The ischial tuberosity supports the body during _____
17. The ischial spine is _____
18. The distance between the ischial spines is _____

19. The pubis constitutes _____
20. The symphysis pubis is _____
21. The pubic arch is _____
22. The obturator foramen is _____

C. Greater and Lesser Pelves

1. The pelvic brim would be marked if _____

2. The pelvic brim separates _____

3. The greater pelvis is bounded posteriorly by _____,
laterally by _____,
and anteriorly by _____

4. The false pelvis supports _____
5. The lesser pelvis is bounded posteriorly by _____
and laterally and anteriorly by _____

D. Differences Between Male and Female Pelves

1. Usually the female iliac bones are _____ than those of the male.
2. The female hips are usually _____ than those of the male.
3. The angle of the female pubic arch may be _____
4. The female pelvic cavity is usually _____ than that of the male.
5. The bones of the female pelvis are _____
and show less evidence of _____

XI. Lower Limb

A. Introduction

1. The bones of the lower limb form the framework of _____

2. The bones of the lower limb are _____

B. Femur

1. The femur extends from _____
2. The head of the femur projects _____
3. The fovea capitis is _____
and marks the attachment of _____
4. The neck of the femur is _____
5. Two large processes below the neck of the femur are _____

6. The linea aspera is _____
7. The lateral and medial condyles articulate with _____

8. The patella articulates with the femur on its _____
9. The medial and lateral epicondyles provide attachments for _____

C. Patella

1. The patella is a _____ bone located in _____
2. The patella controls _____

D. Tibia

1. The shinbone is _____
2. The tibia is located on _____ side.
3. The medial and lateral condyles of the tibia articulate with _____

4. The tibial tuberosity is located _____
5. The tibial tuberosity provides an attachment for _____
6. The anterior crest of the tibia is _____
7. The medial malleolus is _____
8. On the tibia's lateral side is a depression that articulates with _____

9. The inferior surface of the tibia's distal end articulates with _____

E. Fibula

1. The fibula is on the _____ side of the tibia.
2. The head of the fibula articulates with _____
3. The lateral malleolus articulates with _____

F. Ankle and Foot

1. The ankle and foot consist of _____
2. The tarsus is composed of _____
3. The talus articulates with _____
and can move _____
4. The seven tarsal bones are _____

5. The largest talus is the _____
6. The calcaneus helps support _____
7. The metatarsus consists of _____
8. The heads at the distal ends of the metatarsals form _____

9. The arch of the foot is formed by _____
10. The bones of the toes are called _____
11. Each toe has _____ phalanges except the great toe because it lacks _____

XII. Life-Span Changes

- A. An incremental decrease in height begins at about _____
- B. _____ of the vertebrae may contribute to loss of height.
- C. As calcium levels fall, bones become _____ and prone to _____
- D. Gradually, _____ come to outnumber _____
- E. By age _____ all adults start to lose bone mass.
- F. _____ bone shows signs of aging first.
- G. Compact bone loss begins around the age of _____
- H. In the first decade following menopause _____ of trabecular bone is lost and _____ of compact bone is lost in women.
- I. The most common fractures in the elderly are _____
- J. Preserving skeletal health may involve _____

Chapter 7

Skeletal System

Part A

1. List four groups of bones based upon their shapes, and name an example from each group.
 - a. **Long bones**—femur and humerus
 - b. **Short bones**—tarsals and carpals
 - c. **Flat bones**—ribs, scapulae, and bones of the skull
 - d. **Irregular bones**—vertebrae and many facial bones
2. Sketch a typical long bone, and label its epiphyses, diaphysis, medullary cavity, periosteum, and articular cartilages.
See figure 7.2, page 183.
3. Distinguish between spongy and compact bone.
Compact bone is comprised of tightly packed tissue that is strong, solid, and resistant to bending. **Spongy bone** consists of numerous branching bony plates.

Irregular interconnected spaces occur between these plates, thus reducing the weight of the bone.

4. Explain how central canals and perforating canals are related.

Central canals (*Haversian canals*) contain one or two small blood vessels and a nerve, surrounded by loose connective tissue. These vessels provide nourishment for the bone cells associated with the osteonic canals. The osteonic canals run longitudinally. **Perforating canals** (*Volkman's canals*) run transversely and contain larger blood vessels and nerves by which the vessels and nerves in osteonic canals communicate with the surface of the bone and the medullary cavity.

5. Explain how the development of intramembranous bone differs from that of endochondral bone.

Intramembranous bones develop from sheetlike masses of connective tissue. Some of the primitive connective tissue cells enlarge and differentiate into osteoblasts. Spongy bone tissue is produced in all directions by these osteoblasts in the membrane. Eventually, the periosteum is developed by outside cells of the membrane of the developing bone. **Endochondral bones** develop of masses of hyaline cartilage with shapes similar to the future bone structures. These models grow rapidly for a while, and then begin to undergo extensive changes. The center of the diaphysis in long bones breaks down and disappears. At the same time, a periosteum forms from connective tissues that encircle the developing diaphysis. The primary ossification center is formed. Later on, the secondary ossification centers form and spongy bone forms from this.

6. Distinguish between osteoblasts and osteocytes.

Osteoblasts are bone-forming cells. **Osteocytes** are mature bone cells surrounded by matrix.

7. Explain the function of an epiphyseal plate.

The **epiphyseal plate** is a band of cartilage that is left between the primary and secondary ossification centers. This plate includes rows of young cells that are undergoing mitosis and producing new cells. As the epiphyseal plate thickens due to the new cells, bone length is increased.

8. Explain how a bone grown in thickness.

A developing bone grows in thickness as compact bone tissue is deposited on the outside, just beneath the periosteum. Bone tissue is being eroded away on the inside by osteoclasts.

9. **Define *osteoclast*.**
Osteoclasts are large multinucleated cells that break down the calcified matrix.
10. **Explain how osteoclasts and osteoblasts regulate bone mass.**
Osteoclasts secrete an acid that dissolves the inorganic component of the calcified matrix, and their lysosomal enzymes digest the organic components. After the osteoclasts remove the matrix, bone building **osteoblasts** invade the regions and deposit bone tissue.
11. **Describe the effects of vitamin deficiencies on bone development.**
Vitamin D is necessary for proper absorption of calcium in the small intestine. If this is lacking, *rickets* can develop or *osteomalacia* in adults. **Vitamin A** is necessary for bone resorption during normal development. **Vitamin C** is needed for collagen synthesis. Lacking either Vitamin A or C can hinder normal bone growth.
12. **Explain the causes of pituitary dwarfism and gigantism.**
Pituitary dwarfism results from the failure of the pituitary gland to secrete adequate amounts of growth hormone. **Pituitary gigantism** results from the pituitary gland secreting an excessive amount of growth hormone prior to epiphyseal disk ossification.
13. **Describe the effects of thyroid and sex hormones on bone development.**
Thyroid hormone stimulates the replacement of cartilage in the epiphyseal disks of long bones with bone tissue. Thyroid hormone can halt bone growth by causing premature ossification of the epiphyseal disks. A deficiency in thyroid hormone may stunt growth as the pituitary gland depends upon thyroid hormone to stimulate the secretion of growth hormone. **Sex hormones** promote the formation of bone tissue. Female sex hormones have a slightly stronger effect than male sex hormones, allowing females to reach their maximum heights at an earlier age than males.
14. **Explain the effects of exercise on bone structure.**
Physical exercise causes the skeletal muscle to contract and the resulting stress stimulates the bone tissue to thicken and strengthen. On the other hand, lack of physical exercise causes bone to thin and weaken.
15. **Provide several examples to illustrate how bones support and protect body parts.**
Bones of the feet, legs, pelvis, and backbone support the weight of the body. The bones of the skull protect the brain. The rib cage and shoulder girdle protect the heart and lungs.
16. **Describe a lever, and explain how its parts may be arranged to form first-, second-, and third-class levers.**

A **lever** has four basic components: (a) a rigid bar or rod; (b) a pivot, or fulcrum, on which the bar turns; (c) an object or resistance (weight) that is moved; and a force that supplies the energy for the movement of that part.

A **first-class lever** has the sequence of resistance-pivot-force. Example of first-class levers would include scissors, seesaw, or hemostats. A **second-class lever** has the sequence of pivot-resistance-force. An example of a second-class lever would be a wheelbarrow. A **third-class lever** would have the sequence of resistance-force-pivot. Examples of third-class levers would include eyebrow tweezers or forceps.

17. Explain how upper limb movements function as levers.

The upper limb is a first-class lever as the forearm bones serve as the rigid bar while the hand is the resistance and the elbow joint is the pivot. The triceps brachii supply the force. This movement is when the forearm is straightened.

18. Describe the functions of red and yellow bone marrow.

Red marrow functions in the formation of red blood cells, white blood cells, and blood platelets. Its red color is derived from the oxygen-carrying pigment hemoglobin. **Yellow marrow** functions in fat storage and is inactive in blood cell production.

19. Explain the mechanism that regulates the concentration of blood calcium ions.

When the blood is low in calcium, parathyroid hormone stimulates the osteoclasts to break down bone tissue, releasing calcium salts from the intercellular matrix into the blood. Conversely very high blood calcium inhibits the osteoclast activity, and calcitonin from the thyroid gland stimulates the osteoblasts to form bone tissue, storing the excess calcium in the matrix.

20. List three substances that may be abnormally stored in bone.

Bone tissue may accumulate **lead, radium, or strontium.**

21. Distinguish between the axial and appendicular skeletons.

The **axial skeleton** consists of the bones that make up the skull, the hyoid bone, the vertebral column, and the thoracic cage. The **appendicular skeleton** consists of the pectoral girdle, the bones that comprise the upper and lower limbs, and the pelvic girdle.

22. Name the bones of the cranium and facial skeleton.

The bones of the cranium include one **frontal** bone, two **parietal** bones, one **occipital** bone, two **temporal** bones, one **sphenoid** bone, and one **ethmoid** bone.

The bones of the facial skeleton include two **maxilla** bones, two **palatine** bones, two

zygomatic bones, two **lacrimal** bones, two **nasal** bones, one **vomer** bone, two **inferior nasal conchae** bones, and one **mandible** bone.

23. **Explain the importance of fontanels.**

Fontanels permit some movement between the bones so that the developing skull is partially compressible and can change shape slightly. This allows the infant's skull to pass more easily through the birth canal.

24. **Describe a typical vertebra.**

A **typical vertebra** contains the following that are generic to all types:

- a. **Body**—The body is drum-shaped and forms the thick anterior portion of the bone.
- b. **Pedicles**—These consist of two short stalks and project posteriorly.
- c. **Laminae**—These are two plates that arise from the pedicles and fuse in the back.
- d. **Spinous process**—These results from the laminae fusing.
- e. **Vertebral arch**—A bony arch comprised of the pedicles, laminae, and spinous process.
- f. **Vertebral foramen**—The opening through which the spinal cord passes.
- g. **Transverse process**—Projections from each side between the pedicles and laminae.
- h. **Superior and inferior articulating processes**—Cartilage covered facets that project either upward or downward where the vertebrae are joined to the one above and below it.
- i. **Intervertebral foramina**—Notches on the lower surfaces of the vertebral pedicles that form openings, which provide passageways for the spinal nerves that, communicate with the spinal cord.

25. **Explain the differences among cervical, thoracic, and lumbar vertebrae.**

The **cervical vertebrae** are distinctive due to the bifid spinous processes and transverse foramina in the transverse process. The **thoracic vertebrae** are larger than the cervical vertebrae and have long, pointed spinous processes that slope downward, and facets on the side of their bodies that articulate with a rib. Starting with the third thoracic vertebrae, the bodies of these vertebrae increase in size. The **lumbar vertebrae** have the largest bodies and short, stubby spinous processes.

26. **Describe the locations of the sacroiliac joint, the sacral promontory, and the sacral hiatus.**

The **sacroiliac joint** occurs where the sacrum is wedged between the coxal bones of the pelvis and is united to them at its auricular surfaces by fibrocartilage. The **sacral promontory** is the upper anterior margin of the sacrum. Physicians use this to determine pelvis size for childbirth. The **sacral hiatus** is the opening at the tip of the sacrum dorsally.

27. **Names the bones that comprise the thoracic cage.**

The **thoracic cage** includes the **ribs**, **thoracic vertebrae**, **sternum**, and **costal cartilages** that attach the ribs to the sternum.

28. **List the bones that form the pectoral and pelvic girdles.**

The **pectoral girdle** consists of two **clavicles** and two **scapulae**. The **pelvic girdle** consists of two **coxal bones** that articulate with each other anteriorly and with the sacrum posteriorly.

29. Name the bones of the upper limb.

The bones of the upper limb include a **humerus**, a **radius**, an **ulna**, and several **carpals**, **metacarpals**, and **phalanges**.

30. Name the bones that comprise a coxa.

A **coxal bone** develops from three parts—an **ilium**, an **ischium**, and a **pubis** that fuse together.

31. List the major differences that may occur between the male and female pelvis.

The female iliac bones are more flared than the males. The angle of the female pubic arch may be greater. There may be more distance between the ischial spines and the ischial tuberosities. The sacral curvature may be shorter and flatter. The bones of the female pelvis are usually lighter, more delicate, and show less evidence of muscle attachments.

32. List the bones of the lower limb.

The bones of the lower limb include a **femur**, a **tibia**, a **fibula**, and several **tarsals**, **metatarsals**, and **phalanges**.

33. Describe changes in trabecular bone and compact bone with aging.

Trabecular bone, due to its spongy, less compact nature, shows the changes of aging first, as they thin, increasing in porosity and weakening the overall structure. The vertebrae consist mostly of trabecular bone. It is also found in the upper part of the femur, whereas the shaft is more compact bone. The fact that trabecular bone weakens sooner than compact bone destabilizes the femur, which is why it is a commonly broken bone among the elderly.

Compact bone loss begins at around age forty and continues at about half the rate of loss of trabecular bone. As remodeling continues throughout life, older osteons disappear as new ones are built next to them. With age, the osteons may coalesce, further weakening the overall structures as gaps form.

34. List factors that may preserve skeletal health.

Preserving skeletal health may involve avoiding falls, taking calcium supplements, getting enough vitamin D, avoiding carbonated beverages (phosphates deplete bone), and getting regular exercise.

Part B

Match the parts listed in column I with the bones listed in column II.

I

1. Coronoid process
2. Cribriform plate
3. Foramen magnum
4. Mastoid process
5. Palatine process
6. Sella turcica
7. Supraorbital notch
8. Temporal process
9. Acromion process
10. Deltoid tuberosity
11. Greater trochanter
12. Lateral malleolus
13. Medial malleolus
14. Olecranon process
15. Radial tuberosity
16. Xiphoid process

II

- C. Mandible
- A. Ethmoid bone
- E. Occipital bone
- F. Temporal bone
- D. Maxillary bone
- G. Sphenoid bone
- B. Frontal bone
- H. Zygomatic bone
- M. Scapula
- K. Humerus
- I. Femur
- J. Fibula
- O. Tibia
- P. Ulna
- L. Radius
- N. Sternum