

LABORATORY EXERCISE 12 BONE STRUCTURE AND CLASSIFICATION

Figure Labels

FIG. 12.1

- | | |
|--|-----------------------|
| 1. Articular cartilage (hyaline cartilage) | 6. Periosteum |
| 2. Spongy bone (red marrow) | 7. Proximal epiphysis |
| 3. Medullary cavity | 8. Diaphysis |
| 4. Yellow marrow | 9. Distal epiphysis |
| 5. Compact bone | |

FIG. 12.2

- | | |
|------------------|----------------------|
| 1. Spongy bone | 6. Perforating canal |
| 2. Compact bone | 7. Blood vessels |
| 3. Osteon | 8. Nerve |
| 4. Periosteum | 9. Canaliculus |
| 5. Central canal | 10. Osteocyte |



Critical Thinking Application Answer

The closest blood supply to an osteocyte is located in the central canal of an osteon unit. Nutrients and wastes can move from one cell to another via small cellular processes located in minute tubes in the matrix called canaliculi. In this way, all of the osteocytes of one osteon are tied together to a blood source.

Laboratory Report Answers

PART A

- | | |
|--|---|
| 1. flat | 8. Hyaline cartilage covers the articular ends of a long bone. |
| 2. short | 9. Dense connective tissue comprises the periosteum that encloses the bone except for its articular ends |
| 3. long | 10. Periosteum forms the outer covering of a bone, whereas endosteum lines its hollow, internal chambers. |
| 4. irregular | |
| 5. round or sesamoid | |
| 6. flat | |
| 7. Epiphysis refers to the expanded end of a long bone; diaphysis refers to the shaft between the ends of such a bone. | |

PART B

- | | |
|---|--|
| 1. Compact bone has osteons closely packed together, and spongy bone has large spaces between thin bony plates called trabeculae. | reduces the weight of the bone and provides spaces occupied by red marrow. |
| 2. Compact bone provides strength in the shaft and along the borders of the bone. Spongy bone | 3. The marrow in the medullary cavity of an adult is yellow, but marrow in the spaces of spongy bone is red. |

PART C (figure 12.5a and b)

- | | |
|-------------------------|---------------------|
| 1. Epiphysis (distal) | 4. Medullary cavity |
| 2. Diaphysis | 5. Compact bone |
| 3. Epiphysis (proximal) | 6. Spongy bone |

LABORATORY EXERCISE 13 ORGANIZATION OF THE SKELETON

Figure Labels

FIG. 13.1a

- | | | | |
|----------------------------|--------------------------------|----------------|----------------|
| 1. Cranial bones (cranium) | 5. Sternum | 9. Carpals | 13. Tarsals |
| 2. Facial bones (face) | 6. Rib | 10. Metacarpal | 14. Metatarsal |
| 3. Skull | 7. Vertebral column (vertebra) | 11. Phalanx | 15. Phalanx |
| 4. Clavicle | 8. Coxa (hipbone) | 12. Patella | |

FIG. 13.1b

- | | | | |
|-------------|------------|---------------------------------|------------|
| 16. Scapula | 19. Radius | 22. Fibula | 24. Sacrum |
| 17. Humerus | 20. Femur | 23. Vertebral column (vertebra) | 25. Coccyx |
| 18. Ulna | 21. Tibia | | |



Critical Thinking Application Answer

The largest foramen in the skull is the foramen magnum in the occipital bone. The largest foramen in the human body is the obturator foramen in the coxae (hipbones).

Laboratory Report Answers

PART A

- | | | |
|----------------------------------|--------------------|---------------|
| 1. sutural bones (wormian bones) | 6. sternum | 11. sacrum |
| 2. sesamoid | 7. twelve | 12. pelvis |
| 3. skull | 8. pectoral girdle | 13. patella |
| 4. hyoid | 9. ulna | 14. tarsals |
| 5. coccyx | 10. carpals | 15. phalanges |

PART B

- | | | | |
|------|------|------|------|
| 1. c | 3. a | 5. g | 7. d |
| 2. f | 4. e | 6. b | |

PART C

- | | | | |
|------|------|------|------|
| 1. c | 3. g | 5. b | 7. f |
| 2. a | 4. e | 6. d | |

PART D (figure 13.2)

- | | | | |
|-------------------------------|------------|-------------|-----------|
| 1. Coxa (hipbone; innominate) | 4. Fibula | 8. Clavicle | 12. Tibia |
| 2. Sternum | 5. Ulna | 9. Humerus | 13. Rib |
| 3. Sacrum | 6. Scapula | 10. Patella | |
| | 7. Radius | 11. Femur | |

LABORATORY EXERCISE 14

SKULL

Instructional Suggestion

You might want to have the students use colored pencils to color the bones in figures 14.1 and 14.2. They should use a different color for each of the individual bones in the series. This activity should cause the students to observe the figures more carefully and help them to locate the various bones that are shown from different views in the figures. The students can check their work by referring to the corresponding full-color figures in the textbook.

Figure Labels

FIG. 14.1

- | | |
|--|---|
| 1. Parietal bone | 9. Supraorbital foramen |
| 2. Frontal bone | 10. Nasal bone |
| 3. Coronal suture | 11. Sphenoid bone |
| 4. Temporal bone | 12. Zygomatic bone |
| 5. Perpendicular plate (of ethmoid bone) | 13. Middle nasal concha (of ethmoid bone) |
| 6. Infraorbital foramen | 14. Inferior nasal concha |
| 7. Vomer bone | 15. Maxilla |
| 8. Mandible | 16. Mental foramen |

FIG. 14.2

- | | |
|--|----------------------|
| 1. Parietal bone | 12. Coronal suture |
| 2. Squamous suture | 13. Frontal bone |
| 3. Lambdoid suture | 14. Sphenoid bone |
| 4. Temporal bone | 15. Lacrimal bone |
| 5. Occipital bone | 16. Nasal bone |
| 6. Temporal process (of zygomatic bone) | 17. Zygomatic bone |
| 7. External acoustic meatus | 18. Maxilla |
| 8. Mastoid process | 19. Mandible |
| 9. Styloid process | 20. Coronoid process |
| 10. Mandibular condyle | |
| 11. Zygomatic process (of temporal bone) | |

FIG. 14.3

- | | |
|--------------------|-----------------------------------|
| 1. Maxilla | 8. Occipital condyle |
| 2. Zygomatic bone | 9. Temporal bone |
| 3. Sphenoid bone | 10. Palatine process (of maxilla) |
| 4. Vomer bone | 11. Palatine bone |
| 5. Zygomatic arch | 12. Foramen magnum |
| 6. Styloid process | 13. Lambdoid suture |
| 7. Mastoid process | 14. Occipital bone |

FIG. 14.4

- | | |
|--|--------------------|
| 1. Ethmoid bone | 6. Sphenoid bone |
| 2. Foramen magnum | 7. Temporal bone |
| 3. Crista galli | 8. Sella turcica |
| 4. Cribriform plate (olfactory foramina) | 9. Parietal bone |
| 5. Frontal bone | 10. Occipital bone |

FIG. 14.5

- | | |
|--------------------|----------------------|
| 1. Coronal suture | 10. Lambdoid suture |
| 2. Frontal bone | 11. Occipital bone |
| 3. Sphenoid bone | 12. Sella turcica |
| 4. Frontal sinus | 13. Styloid process |
| 5. Nasal bone | 14. Sphenoidal sinus |
| 6. Maxilla | 15. Vomer bone |
| 7. Parietal bone | 16. Mandible |
| 8. Temporal bone | |
| 9. Squamous suture | |

**Critical Thinking Application Answer**

The cribriform plate of the ethmoid bone with numerous olfactory foramina is a weak location of the cranium. Excessive pressure on the cribriform plate could result in a skull fracture.

Laboratory Report Answers**PART A**

- | | | | |
|------|------|------|-------|
| 1. d | 4. f | 7. f | 10. e |
| 2. a | 5. c | 8. a | 11. f |
| 3. a | 6. f | 9. c | 12. b |

PART B

- | | |
|-------------|-------------------------------|
| 1. coronal | 4. squamous |
| 2. sagittal | 5. frontal, ethmoid, sphenoid |
| 3. lambdoid | 6. maxillary bone |

PART C

- | | | | |
|------|------|------|-------|
| 1. e | 4. h | 7. h | 10. c |
| 2. c | 5. d | 8. a | 11. f |
| 3. c | 6. g | 9. d | 12. b |

PART D

- | | | | |
|------|------|------|------|
| 1. c | 3. g | 5. d | 7. e |
| 2. a | 4. f | 6. b | |

PART E (figures 14.7–14.11)

FIG. 14.7

- | | | | |
|----|----------------------|----|---------------------------------------|
| 1. | Frontal bone | 6. | Mandible |
| 2. | Nasal bone | 7. | Middle nasal concha (of ethmoid bone) |
| 3. | Zygomatic bone | 8. | Inferior nasal concha |
| 4. | Infraorbital foramen | 9. | Mental foramen |
| 5. | Maxilla | | |

FIG. 14.8

- | | | | |
|----|--------------------------|-----|--------------------------------------|
| 1. | Parietal bone | 8. | Mandibular condyle |
| 2. | Squamous suture | 9. | Coronal suture |
| 3. | Temporal bone | 10. | Frontal bone |
| 4. | Lambdoid suture | 11. | Zygomatic process (of temporal bone) |
| 5. | Occipital bone | 12. | Zygomatic bone |
| 6. | External acoustic meatus | 13. | Maxilla |
| 7. | Mastoid process | 14. | Mandible |

FIG. 14.9

- | | | | |
|----|------------------|-----|-----------------------------|
| 1. | Maxilla | 7. | Palatine process of maxilla |
| 2. | Zygomatic bone | 8. | Palatine bone |
| 3. | Sphenoid bone | 9. | Vomer bone |
| 4. | Temporal bone | 10. | Occipital condyle |
| 5. | Occipital bone | 11. | Foramen magnum |
| 6. | Incisive foramen | | |

FIG. 14.10

- | | | | |
|----|----------------|----|----------------|
| 1. | Frontal bone | 5. | Ethmoid bone |
| 2. | Temporal bone | 6. | Sphenoid bone |
| 3. | Parietal bone | 7. | Sella turcica |
| 4. | Occipital bone | 8. | Foramen magnum |

FIG. 14.11

- | | | | |
|----|----------------|----|--------------|
| 1. | Parietal bone | 5. | Maxilla |
| 2. | Sphenoid bone | 6. | Frontal bone |
| 3. | Temporal bone | 7. | Mandible |
| 4. | Zygomatic bone | | |

LABORATORY EXERCISE 15

VERTEBRAL COLUMN AND THORACIC CAGE

Figure Labels

FIG. 15.1

- | | | | |
|----|--------------------|----|-------------------------|
| 1. | Cervical vertebrae | 5. | Coccyx |
| 2. | Thoracic vertebrae | 6. | Intervertebral foramina |
| 3. | Lumbar vertebrae | 7. | Intervertebral discs |
| 4. | Sacrum | | |

FIG. 15.2a and b

- | | | | |
|----|---|----|-------------------------------|
| 1. | Facet that articulates with occipital condyle | 5. | Body |
| 2. | Transverse process | 6. | Superior articular facet |
| 3. | Transverse foramen | 7. | Fovea dentis (facet for dens) |
| 4. | Dens (odontoid process) | 8. | Transverse foramen |

FIG. 15.3a-c

- | | | | |
|----|-------------------------|----|----------------------------|
| 1. | Lamina | 6. | Lamina |
| 2. | Spinous process (bifid) | 7. | Vertebral foramen |
| 3. | Lamina | 8. | Superior articular process |
| 4. | Pedicle | 9. | Body |
| 5. | Body | | |

FIG. 15.4

- | | | | |
|----|----------------------------|----|----------------------------|
| 1. | Superior articular process | 5. | Superior articular process |
| 2. | Anterior sacral foramen | 6. | Tubercle |
| 3. | Coccyx | 7. | Posterior sacral foramen |
| 4. | Sacral canal | 8. | Sacral hiatus |



Critical Thinking Application Answer

The four curvatures allow more resiliency and flexibility, which will enable the vertebral column to function more like a spring instead of a rigid rod.

FIG. 15.5

- | | | | |
|----|-------------------|----|------------------|
| 1. | True ribs | 6. | Xiphoid process |
| 2. | False ribs | 7. | Sternum |
| 3. | Thoracic vertebra | 8. | Costal cartilage |
| 4. | Manubrium | 9. | Floating ribs |
| 5. | Body | | |

Laboratory Report Answers

PART A

- | | |
|-------------------------|-----------------------|
| 1. spinal cord | 9. axis |
| 2. 26 | 10. dens |
| 3. bodies | 11. lumbar |
| 4. intervertebral discs | 12. five |
| 5. spinous process | 13. sacroiliac |
| 6. spinal nerves | 14. sacral promontory |
| 7. vertebral arteries | 15. sacral hiatus |
| 8. atlas | |

PART B

<i>Vertebra</i>	<i>Number</i>	<i>Size</i>	<i>Body</i>	<i>Spinous Process</i>	<i>Transverse Foramina</i>
Cervical	7	Smallest	Smallest	C2 through C5 are forked	Present
Thoracic	12	Intermediate	Intermediate	Pointed and angled downward	Absent
Lumbar	5	Largest	Largest	Short, blunt, and nearly horizontal	Absent

PART C

- | | |
|----------------------|--|
| 1. 206 | 5. clavicles |
| 2. floating | 6. a. supports shoulder girdle and upper limbs |
| 3. transverse | b. protects visceral organs |
| 4. hyaline cartilage | c. functions in breathing |

PART D (figure 15.6)

- | | |
|--------------------|--------------------------------------|
| 1. Spinous process | 4. Transverse process |
| 2. Atlas | 5. Intervertebral disc |
| 3. Axis | 6. Body (of sixth cervical vertebra) |

LABORATORY EXERCISE 16 PECTORAL GIRDLE AND UPPER LIMB

Figure Labels

FIG. 16.1

- | | |
|---------------------|----------------------|
| 1. Clavicle | 7. Ulna |
| 2. Rib | 8. Radius |
| 3. Sternum | 9. Acromion process |
| 4. Costal cartilage | 10. Head |
| 5. Scapula | 11. Coracoid process |
| 6. Humerus | |

FIG. 16.2

- | | |
|-----------------------|---------------------|
| 1. Acromion process | 6. Glenoid cavity |
| 2. Coracoid process | 7. Acromion process |
| 3. Spine | 8. Coracoid process |
| 4. Supraspinous fossa | 9. Glenoid cavity |
| 5. Infraspinous fossa | |



Critical Thinking Application Answer

The clavicles brace the freely movable scapulae, helping to hold the shoulders in place. If an excessive lengthwise force occurs on this structurally weak bone, as when a person breaks a fall with an outstretched rigid upper limb, it is likely to fracture.

FIG. 16.3a and b

- | | |
|-----------------------|-----------------------|
| 1. Head | 8. Capitulum |
| 2. Greater tubercle | 9. Trochlea |
| 3. Lesser tubercle | 10. Greater tubercle |
| 4. Deltoid tuberosity | 11. Anatomical neck |
| 5. Medial epicondyle | 12. Surgical neck |
| 6. Coronoid fossa | 13. Medial epicondyle |
| 7. Lateral epicondyle | 14. Olecranon fossa |

FIG. 16.4

- | | |
|----------------------|---------------------|
| 1. Head of radius | 5. Trochlear notch |
| 2. Radial tuberosity | 6. Coronoid process |
| 3. Styloid process | 7. Head of ulna |
| 4. Olecranon process | |

FIG. 16.5

- | | |
|----------------------|-------------------|
| 1. Olecranon process | 4. Head of radius |
| 2. Humerus | 5. Radius |
| 3. Olecranon fossa | 6. Ulna |

FIG. 16.6

- | | | |
|--------------|-----------------------------|----------------------|
| 1. Scaphoid | 5. Carpals (carpus) | 9. Triquetrum |
| 2. Capitate | 6. Metacarpals (metacarpus) | 10. Proximal phalanx |
| 3. Trapezoid | 7. Phalanges | 11. Middle phalanx |
| 4. Trapezium | 8. Lunate | 12. Distal phalanx |

Laboratory Report Answers**PART A**

- | | |
|---------------------------------|---------------------|
| 1. scapulae | 5. spine |
| 2. manubrium (clavicular notch) | 6. acromion process |
| 3. acromion processes | 7. coracoid process |
| 4. clavicle | 8. head |

PART B

- | | | |
|------|------|-------|
| 1. a | 5. c | 9. b |
| 2. b | 6. d | 10. e |
| 3. b | 7. b | 11. a |
| 4. b | 8. a | 12. f |

PART C (figures 16.7, 16.8, and 16.9)

- | | | |
|----------------------|--------------------|----------------------|
| 1. Ulna | 7. Head of humerus | 13. Metacarpals |
| 2. Humerus | 8. Humerus | 14. Carpals |
| 3. Olecranon process | 9. Clavicle | 15. Distal phalanx |
| 4. Head of radius | 10. Scapula | 16. Proximal phalanx |
| 5. Radius | 11. Rib | |
| 6. Acromion process | 12. Phalanges | |

PART D (figure 16.10)

- | | | |
|---------------|--------------|------------------------|
| 1. Scaphoid | 5. Hamate | 9. Metacarpals |
| 2. Lunate | 6. Capitate | 10. Proximal phalanges |
| 3. Triquetrum | 7. Trapezoid | 11. Middle phalanges |
| 4. Pisiform | 8. Trapezium | 12. Distal phalanges |

LABORATORY EXERCISE 17 PELVIC GIRDLE AND LOWER LIMB

Figure Labels

FIG. 17.1

- | | |
|--|-----------|
| 1. Coxa (hipbone; pelvic bone; innominate) | 3. Coccyx |
| 2. Sacrum | |

FIG. 17.2a

- | | |
|-----------------------------------|----------------------------------|
| 1. Ilium | 7. Ischial tuberosity |
| 2. Posterior superior iliac spine | 8. Iliac crest |
| 3. Greater sciatic notch | 9. Anterior superior iliac spine |
| 4. Ischial spine | 10. Acetabulum |
| 5. Lesser sciatic notch | 11. Pubis |
| 6. Ischium | 12. Obturator foramen |

FIG. 17.2b

- | | |
|-----------------------------------|------------------------------------|
| 13. Anterior superior iliac spine | 17. Iliac fossa |
| 14. Ilium | 18. Posterior superior iliac spine |
| 15. Pubis | 19. Ischial spine |
| 16. Iliac crest | 20. Ischium |



Critical Thinking Application Answer

All the features examined are wider in the female pelvis which will result in a larger pelvic cavity and must also serve as a birth canal for a vaginal delivery.

FIG. 17.3a and b

- | | |
|-----------------------|-----------------------|
| 1. Head | 5. Lateral epicondyle |
| 2. Fovea capitis | 6. Lesser trochanter |
| 3. Greater trochanter | 7. Lateral condyle |
| 4. Neck | 8. Medial condyle |

FIG. 17.4

- | | |
|----------------------|----------------------|
| 1. Head of fibula | 5. Tibial tuberosity |
| 2. Fibula | 6. Tibia |
| 3. Lateral malleolus | 7. Medial malleolus |
| 4. Medial condyle | |

FIG. 17.5

- | | |
|--------------------|-----------|
| 1. Medial condyle | 4. Fibula |
| 2. Femur | 5. Tibia |
| 3. Lateral condyle | |

FIG. 17.6

- | | |
|---------------------------|------------------------------|
| 1. Calcaneus | 8. Proximal phalanx |
| 2. Talus | 9. Middle phalanx |
| 3. Cuboid | 10. Distal phalanx |
| 4. Navicular | 11. Tarsals (tarsus) |
| 5. Lateral cuneiform | 12. Metatarsals (metatarsus) |
| 6. Intermediate cuneiform | 13. Phalanges |
| 7. Medial cuneiform | |

Laboratory Report Answers**PART A**

- | | | | |
|---------------------|--------------------|----------------------|----------------|
| 1. coxae (hipbones) | 4. ischial spines | 7. tuberosity | 10. sacroiliac |
| 2. acetabulum | 5. symphysis pubis | 8. pubic arch | |
| 3. ilium | 6. iliac crest | 9. obturator foramen | |

PART B

- | | | | |
|------|------|------|-------|
| 1. e | 4. a | 7. g | 10. b |
| 2. a | 5. f | 8. f | 11. d |
| 3. g | 6. f | 9. a | 12. c |

PART C (figures 17.7, 17.8, and 17.9)

- | | | |
|----------------------|-----------------------|----------------------|
| 1. Obturator foramen | 7. Femur | 13. Tibia |
| 2. Symphysis pubis | 8. Tibia | 14. Talus |
| 3. Ilium | 9. Lateral epicondyle | 15. Calcaneus |
| 4. Sacrum | 10. Lateral condyle | 16. Metatarsal |
| 5. Head of femur | 11. Head of fibula | 17. Proximal phalanx |
| 6. Pubis | 12. Fibula | 18. Distal phalanx |

PART D (figure 17.10)

- | | | |
|-----------------------|---------------------------|---------------------|
| 1. Distal phalanges | 5. Intermediate cuneiform | 9. Middle phalanges |
| 2. Proximal phalanges | 6. Lateral cuneiform | 10. Cuboid |
| 3. Metatarsals | 7. Navicular | 11. Calcaneus |
| 4. Medial cuneiform | 8. Talus | |