

## 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 Answers

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 irregular connective tissue comprises the periosteum that encloses the bone except for its articular ends  |
| 3. Long  | 10. Periosteum composed of irregular dense connective tissue forms the outer covering of a bone, whereas endosteum composed of reticular connective tissue lines its hollow, internal chambers. |
| 4. Irregular   |   |
| 5. Sesamoid or round   |   |
| 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.  | 3. The marrow of the medullary cavity of an adult is yellow, but marrow in the spaces of spongy bone is red. |
| 2. Compact bone provides strength in the shaft and along the borders of the bone. Spongy bone reduces the weight of the bone and provides spaces occupied by red marrow. |  |

#### PART C (FIG. 12.5 a-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. 3.1a**

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

**FIG. 13.1b**

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

**Critical Thinking Application Answers**

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 hip bones.

**Laboratory Report Answers****PART A**

- |                                  |                    |               |
|----------------------------------|--------------------|---------------|
| 1. Sutural bones (wormian bones) | 6. Sternum         | 11. Sacrum    |
| 2. Axial                         | 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 (FIG. 13.2)**

- |             |             |             |         |
|-------------|-------------|-------------|---------|
| 1. Hip bone | 5. Ulna     | 9. Humerus  | 13. Rib |
| 2. Sternum  | 6. Scapula  | 10. Patella |         |
| 3. Sacrum   | 7. Radius   | 11. Femur   |         |
| 4. Fibula   | 8. Clavicle | 12. Tibia   |         |

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

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



### **Critical Thinking Application Answers**

The cribiform plate of the ethmoid bone with numerous olfactory foramina is a weak location of the cranium. Excessive pressure on the cribiform 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 (FIG. 14.8-14.12)**

##### **FIG. 14.8**

- |                         |  |
|-------------------------|--|
| 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. 14.9**

- |                             |  |
|-----------------------------|--|
| 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. 14.10**

- |                     |                                |
|---------------------|--------------------------------|
| 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. 14.11**

- |                   |                   |
|-------------------|-------------------|
| 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. 14.12**

- |                   |                 |
|-------------------|-----------------|
| 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. 15.2 a-b**

- |   |   |
|---|---|
| 8 | 1 |
| 3 | 6 |
| 4 | 5 |
| 7 | 2 |

#### **FIG. 15.3 a-c**

- |   |   |
|---|---|
| 6 | 1 |
| 7 | 9 |
| 3 | 2 |
| 5 | 8 |
| 4 |   |

#### **FIG. 15.4**

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



### Critical Thinking Application Answers

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          | 8. Atlas              |
| 2. 26                   | 9. Axis               |
| 3. Bodies               | 10. Dens              |
| 4. Intervertebral discs | 11. Lumbar            |
| 5. Spinous process      | 12. Five              |
| 6. Spinal nerves        | 13. Sacral promontory |
| 7. Vertebral arteries   | 14. Sacral hiatus     |

**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
2. Floating
3. Seven
4. Hyaline cartilage
5. Clavicles
6.
  - a. Supports shoulder girdle and upper limbs
  - b. Protects visceral organs
  - c. Functions in breathing

**PART D (FIG. 15.6)**

1. Spinous process
2. Atlas
3. Axis
4. Transverse process
5. Intervertebral disc
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 of humerus  |
| 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 Answers**

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-b**

- |                       |                      |
|-----------------------|----------------------|
| 1. Head               | 6. Capitulum         |
| 2. Lesser tubercle    | 7. Trochlea          |
| 3. Deltoid tuberosity | 8. Greater tubercle  |
| 4. Coronoid fossa     | 9. Medial epicondyle |
| 5. Lateral epicondyle | 10. Olecranon fossa  |

**FIG. 16.4**

- |                              |                     |
|------------------------------|---------------------|
| 1. Head of radius            | 5. Trochlear notch  |
| 2. Radial tuberosity         | 6. Coronoid process |
| 3. Styloid process of radius | 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                 | 7. Phalanges        |
| 2. Capitate                 | 8. Lunate           |
| 3. Trapezoid                | 9. Proximal phalanx |
| 4. Trapezium                | 10. Middle phalanx  |
| 5. Carpals (carpus)         | 11. Distal phalanx  |
| 6. Metacarpals (metacarpus) |                     |

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

**PART C (FIGS. 16.7, 16.8, and 16.9)**

**FIG. 16.7**

1. Humerus
2. Olecranon process
3. Head of radius
4. Radius
5. Ulna

**FIG. 16.8**

1. Acromion process
2. Head of humerus
3. Humerus
4. Clavicle
5. Scapula
6. Rib

**FIG. 16.9**

1. Phalanges
2. Metacarpals
3. Carpals
4. Distal phalanx
5. Proximal phalanx

**PART D (FIG. 16.10)**

- 6
- 12
- 5
- 2
- 9
- 11
- 4
- 10
- 1
- 8
- 7
- 3

**LABORATORY EXERCISE 17  
PELVIC GIRDLE AND LOWER LIMB**

**Figure Labels**

**FIG. 17.1**

- |   |           |
|---|-----------|
| 1. Hip bone (coxa; pelvic bone; innominate) | 3. Coccyx |
| 2. Sacrum                                   |           |

**FIG. 17.2a**

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

**FIG. 17.2b**

- |                                   |                   |
|-----------------------------------|-------------------|
| 10. Anterior superior iliac spine | 13. Iliac crest   |
| 11. Ilium                         | 14. Ischial spine |
| 12. Pubis                         | 15. Ischium       |



**Critical Thinking Application Answers**

All of 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-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. Hip bones  | 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 (FIGS. 17.7, 17.8, and 17.9)**

**FIG. 17.7**

1. Obturator foramen
2. Symphysis pubis
3. Ilium
4. Sacrum
5. Head of femur
6. Pubis

**FIG. 17.8**

1. Lateral epicondyle
2. Lateral condyle
3. Head of fibula
4. Fibula
5. Femur
6. Tibia

**FIG. 17.9**

1. Metatarsal
2. Proximal phalanx
3. Distal phalanx
4. Tibia
5. Talus
6. Calcaneus

**PART D (FIG. 17.10)**

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