THE SKELETAL SYSTEM

The skeleton is constructed of two of the most supportive tissues found in the human body—cartilage and bone. Besides supporting and protecting the body's internal framework, the skeleton provides a system of levers that the skeletal muscles use to move the body. In addition, the bones provide a storage depot for substances such as lipids and calcium, and blood cell formation occurs within their red marrow cavities.

The skeleton consists of bones connected at joints, or articulations, and is subdivided into two divisions. The axial skeleton includes those bones that lie around the body's center of gravity. The appendicular skeleton includes the bones of the limbs.

Topics for student review include structure and function of long bones, location and naming of specific bones in the skeleton, fracture types, and a classification of joint types in the body.

BONES—AN OVERVIEW

1. Classify each of the following terms as a projection (P) or a depression or opening (D). Enter the appropriate letter in the answer blanks.

   ____ 2. Crest ______ 5. Head ______ 8. Spine

2. Group each of the following bones into one of the four major bone categories. Use L for long bone, S for short bone, F for flat bone, and I for irregular bone. Enter the appropriate letter in the space provided.

   ____ 2. Frontal ______ 5. Mandible ______ 8. Sternum
3. Using the key choices, characterize the following statements relating to long bones. Enter the appropriate term(s) or letter(s) in the answer blanks.

**Key Choices**

A. Diaphysis          C. Epiphysis          E. Yellow marrow cavity
B. Epiphyseal plate   D. Red marrow

1. Site of spongy bone in the adult
2. Site of compact bone in the adult
3. Site of hematopoiesis in the adult
4. Scientific name for bone shaft
5. Site of fat storage in the adult
6. Site of longitudinal growth in a child

4. Complete the following statements concerning bone formation and destruction, using the terms provided in the key. Insert the key letter or corresponding term in the answer blanks.

**Key Choices**

A. Atrophy          C. Gravity          E. Osteoclasts          G. Parathyroid hormone
B. Calcitonin       D. Osteoblasts       F. Osteocytes          H. Stress and/or tension

1. When blood calcium levels begin to drop below homeostatic levels, ____(1)___ is released, causing calcium to be released from bones.
2. Mature bone cells, called ____(2)___, maintain bone in a viable state.
3. Disuse such as that caused by paralysis or severe lack of exercise results in muscle and bone ____(3)___.
4. Large tubercles and/or increased deposit of bony matrix occur at sites of ____(4)___.
5. Immature, or matrix-depositing, bone cells are referred to as ____(5)___.
6. ____(6)___ causes blood calcium to be deposited in bones as calcium salts.
7. Bone cells that liquefy bone matrix and release calcium to the blood are called ____(7)___.
8. Our astronauts must do isometric exercises when in space because bones atrophy under conditions of weightlessness or lack of ____(8)___.
5. Five descriptions of bone structure are provided in Column A. First identify the structure by choosing the appropriate term from Column B and placing the corresponding answer in the answer blank. Then consider Figure 5–1A, a diagrammatic view of a cross section of bone, and Figure 5–1B, a higher magnified view of compact bone tissue. Select different colors for the structures and bone areas in Column B, and use them to color the coding circles and corresponding structures on the figure diagrams. Because the concentric lamellae would be difficult to color without confusing other elements, identify one lamella by using a bracket and label.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Layers of calcified matrix</td>
<td>A. Central (Haversian) canal ○</td>
</tr>
<tr>
<td>2. &quot;Residences&quot; of osteocytes</td>
<td>B. Concentric lamellae</td>
</tr>
<tr>
<td>3. Longitudinal canal, carrying blood vessels</td>
<td>C. Lacunae ○</td>
</tr>
<tr>
<td>and nerves</td>
<td>D. Canaliculi ○</td>
</tr>
<tr>
<td>4. Nonliving, structural part of bone</td>
<td>E. Bone matrix ○</td>
</tr>
<tr>
<td>5. Tiny canals, connecting lacunae</td>
<td>F. Osteocyte ○</td>
</tr>
</tbody>
</table>

**Figure 5–1**

6. Circle the term that does not belong in each of the following groupings.

1. Hematopoiesis     Red marrow     Yellow marrow     Spongy bone
2. Lamellae          Canaliculi     Circulation       Osteoblasts
3. Osteon            Marrow cavity   Central canal     Canaliculi
4. Epiphysis surface Articular cartilage     Periosteum     Hyaline cartilage
7. Figure 5–2A is a midlevel, cross-sectional view of the diaphysis of the femur. Label the membrane that lines the cavity and the membrane that covers the outside surface.

Figure 5–2B is a drawing of a longitudinal section of the femur. Color the bone tissue gold. Do not color the articular cartilage; leave it white. Select different colors for the bone regions listed at the coding circles below. Color the coding circles and the corresponding regions on the drawing. Complete Figure 5–2B by labeling compact bone and spongy bone.

- Diaphysis
- Area where red marrow is found
- Epiphyseal plate
- Area where yellow marrow is found

8. The following events apply to the endochondral ossification process as it occurs in the primary ossification center. Put these events in their proper order by assigning each a number (1–6).

1. Cavity formation occurs within the hyaline cartilage.
2. Collar of bone is laid down around the hyaline cartilage model just beneath the periosteum.
3. Periosteal bud invades the marrow cavity.
4. Perichondrium becomes vascularized to a greater degree and becomes a periosteum.
5. Osteoblasts lay down bone around the cartilage spicules in the bone’s interior.
6. Osteoclasts remove the cancellous bone from the shaft interior, leaving a marrow cavity that then houses fat.
AXIAL SKELETON

Skull

9. Using the key choices, identify the bones indicated by the following descriptions. Enter the appropriate term or letter in the answer blanks.

Key Choices
A. Ethmoid
B. Frontal
C. Hyoid
D. Lacrimals
E. Mandible
F. Maxillae
G. Nasals
H. Occipital
I. Palatines
J. Parietals
K. Sphenoid
L. Temporals
M. Vomer
N. Zygomatic

1. Forehead bone
2. Cheekbone
3. Lower jaw
4. Bridge of nose
5. Posterior part of hard palate
6. Much of the lateral and superior cranium
7. Most posterior part of cranium
8. Single, irregular, bat-shaped bone, forming part of the cranial floor
9. Tiny bones, bearing tear ducts
10. Anterior part of hard palate
11. Superior and middle nasal conchae formed from its projections
12. Site of mastoid process
13. Site of sella turcica
14. Site of cribriform plate
15. Site of mental foramen
16. Site of styloid process
17.  Four bones, containing paranasal sinuses
18.  
19.  
20.  
21.  Its condyles articulate with the atlas
22.  Foramen magnum contained here
23.  Middle ear found here
24.  Nasal septum
25.  Bears an upward protrusion, the “cock’s comb,” or crista galli
26.  Site of external acoustic meatus
12. An anterior view of the skull, showing the positions of the sinuses, is provided in Figure 5–4. First select different colors for each of the sinuses and use them to color the coding circles and the corresponding structures on the figure. Then briefly answer the following questions concerning the sinuses.

- Sphenoid sinus
- Ethmoid sinuses
- Frontal sinus
- Maxillary sinus

**Figure 5–4**

1. What are sinuses? __________________________________________________________

2. What purpose do they serve in the skull? _______________________________________
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________

3. Why are they so susceptible to infection? _______________________________________
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________
**Cervical Column**

Key choices, correctly identify the vertebral parts/areas described as Enter the appropriate term(s) or letter(s) in the spaces provided.

**Key Choices**

**1.** Structure that encloses the nerve cord

**2.** Weight-bearing part of the vertebra

**3.** Provide(s) levers for the muscles to pull against

**4.** Provide(s) an articulation point for the ribs

**5.** Openings allowing spinal nerves to pass

The following statements provide distinguishing characteristics of the vertebra composing the vertebral column. Using the key choices, identify each described structure or region by inserting the appropriate term(s) or letter(s) in the spaces provided.

**Key Choices**

**A.** Atlas

**B.** Axis

**C.** Cervical vertebra—typical

1. Type of vertebra(e) containing foramina in the transverse processes, through which the vertebral arteries ascend to reach the brain

2. Its dens provides a pivot for rotation of the first cervical vertebra

3. Transverse processes have facets for articulation with ribs; spinous process points sharply downward

4. Composite bone; articulates with the hip bone laterally

5. Massive vertebrae; weight-sustaining

6. Tailbone; vestigial fused vertebrae

7. Supports the head; allows the rocking motion of the occipital condyles

8. Seven components; unfused

9. Twelve components; unfused
15. Complete the following statements by inserting your answers in the answer blanks.

1. In describing abnormal curvatures, it could be said that (1) is an exaggerated thoracic curvature, and in (2) the vertebral column is displaced laterally.

2. Invertebral discs are made of (3) tissue. The discs provide (4) to the spinal column.

16. Figure 5–5, A–D shows superior views of four types of vertebrae. In the spaces provided below each vertebra, indicate in which region of the spinal column it would be found. In addition, specifically identify Figure 5–5A. Where indicated by leader lines, identify the vertebral body, spinous and transverse processes, superior articular processes, and vertebral foramen.

Figure 5–5
17. Figure 5-6 is a lateral view of the vertebral column. Identify each numbered region of the column by listing in the numbered answer blanks the region name first and then the specific vertebrae involved (for example, sacral region, S# to S#). Also identify the modified vertebrae indicated by numbers 6 and 7 in Figure 5-6. Select different colors for each vertebral region and use them to color the coding circles and the corresponding regions.

1. ____________  
2. ____________  
3. ____________  
4. ____________  
5. ____________  
6. ____________  
7. ____________
Thoracic Cage

18. Complete the following statements referring to the thoracic cage by inserting your responses in the answer blanks.

1. The organs protected by the thoracic cage include the ___1___ and the ___2___. Ribs 1 through 7 are called ___3___ ribs, whereas ribs 8 through 12 are called ___4___ ribs. Ribs 11 and 12 are also called ___5___ ribs. All ribs articulate posteriorly with the ___6___, and most connect anteriorly to the ___7___, either directly or indirectly.

5. The general shape of the thoracic cage is ___8___.

19. Figure 5–7 is an anterior view of the thoracic cage. Select different colors to identify the structures below and color the coding circles and corresponding structures. Then label the subdivisions of the sternum indicated by leader lines.

- All true ribs
- All false ribs
- Costal cartilages
- Sternum

Figure 5–7
APPENDICULAR SKELETON

Several bones forming part of the upper limb and/or shoulder girdle are shown in Figures 5–8 to 5–11. Follow the specific directions for each figure.

20. Identify the bone in Figure 5–8. Insert your answer in the blank below the illustration. Select different colors for each structure listed below and use them to color the coding circles and the corresponding structures in the diagram. Then, label the angles indicated by leader lines.

- Spine
- Glenoid cavity
- Coracoid process
- Acromion

![Figure 5–8](image-url)
21. Identify the bones in Figure 5–9 by labeling the leader lines identified as A, B, and C. Color the bones different colors. Using the following terms, complete the illustration by labeling all bone markings provided with leader lines.

- Trochlear notch
- Trochlea
- Radial tuberosity
- Capitulum
- Deltoid tuberosity
- Head (three)
- Coronoid process
- Olecranon process
- Greater tubercle
- Styloid process
- Lesser tubercle

![Figure 5–9](image-url)
22. Figure 5–10 is a diagram of the hand. Select different colors for the following structures, and use them to color the coding circles and the corresponding structures in the diagram.

- Carpals
- Metacarpals
- Phalanges

![Hand Diagram](image)

23. Compare the pectoral and pelvic girdles by choosing descriptive terms from the key choices. Insert the appropriate key letters in the answer blanks.

**Key Choices**

- A. Flexibility
- B. Massive
- C. Lightweight
- D. Shallow socket for limb attachment
- E. Deep, secure socket for limb attachment
- F. Weight-bearing

Pectoral: _____, _____, _____

Pelvic: _____, _____, _____
25. Figure 5–11 is a diagram of the articulated pelvis. Identify the bones and bone markings indicated by leader lines on the figure. Select different colors for the structures listed below and use them to color the coding circles and the corresponding structures in the figure. Also, label the dashed line showing the dimensions of the true pelvis and that showing the diameter of the false pelvis. Complete the illustration by labeling the following bone markings: obturator foramen, iliac crest, anterior superior iliac spine, ischial spine, pubic ramus, and pelvic brim. Last, list three ways in which the female pelvis differs from the male pelvis and insert your answers in the answer blanks.

- Coxal bone
- Sacrum
- Acetabulum

Figure 5–11

1. __________________________________________________________________________

2. __________________________________________________________________________

3. __________________________________________________________________________

26. Circle the term that does not belong in each of the following groupings.

1. Tibia  Ulna  Fibula  Femur
   2. Skull  Rib cage  Vertebral column  Pelvis
   3. Ischium  Scapula  Ilium  Pubis
   4. Mandible  Frontal bone  Temporal bone  Occipital bone
   5. Calcaneus  Tarsals  Carpals  Talus
29. The bones of the thigh and the leg are shown in Figure 5-12. Identify each and put your answers in the blanks labeled A, B, and C. Select different colors for the lower limb bones listed below and use them to color in the coding circles and corresponding bones on the diagram. Complete the illustration by inserting the terms indicating bone markings at the ends of the appropriate leader lines in the figure.

- Femur
  - Head of femur
  - Intercondylar eminence
  - Tibial tuberosity

- Tibia
  - Anterior border of tibia
  - Lesser trochanter
  - Greater trochanter

- Fibula
  - Head of fibula
  - Medial malleolus
  - Lateral malleolus

![Figure 5-12](image-url)
30. Figure 5–13 is a diagram of the articulated skeleton. Identify all bones or groups of bones by writing the correct labels at the end of the leader lines. Then, select two different colors for the bones of the axial and appendicular skeletons and use them to color in the coding circles and corresponding structures in the diagram.

- Axial skeleton
- Appendicular skeleton

Figure 5–13