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 as an 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 goes on within the red marrow cavities of bones.

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 and girdles.

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. 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.

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. Items may have more than one answer.

**Key Choices**

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

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 choices. Insert the key letter or corresponding term in the answer blanks.

**Key Choices**

A. Atrophy  
B. Calcitonin  
C. Gravity  
D. Osteoblasts  
E. Osteoclasts  
G. Parathyroid hormone

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.
   (A) Identify the structure by choosing the appropriate term from Column B
       and placing the corresponding answer in the answer blank.
   (B) Select different colors for the structures and bone areas in Column B
       and use them to color the coding circles and corresponding structures on
       Figure 5-1, diagrams A and B.
   (C) Identify one lamella on diagram A by using a bracket and label (the concentric
       lamellae would be difficult to color without confusing other structures).

   Column A
   B. Concentric lamellae
   C. Lacunae
   A. Central canal
   E. Bone matrix
   D. Canaliculi

   Column B
   A. Central (Haversian) canal
   B. Concentric lamellae
   C. Lacunae
   D. Canaliculi
   E. Bone matrix
   F. Osteocyte

   A (diagrammatic view of a cross section of bone)
   B (higher magnification view of compact bone tissue)

   Figure 5–1

6. Circle the term that does not belong in each of the following groupings. Then,
   fill in the answer blanks with the correct group name.

   1. Hematopoiesis Red marrow Yellow marrow Spongy bone
      Group: Formation
   2. Lamellae Canaliculi Circulation Osteoblasts
      Group: Blood supply
   3. Osteocyte Marrow cavity Central canal Canaliculi
      Group: Osteon
   4. Spongy bone Articular cartilage Periosteum Hyaline cartilage
      Group: Epiphysis
7. Figure 5–2A is a mid-level, cross-sectional view of the diaphysis of the femur.
(A) 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.
(B) Color the bone tissue gold. Do not color the articular cartilage; leave it white.
(C) Select different colors for the bone regions listed at the coding circles below. Color the coding circles and the corresponding regions on the drawing (Figure 5–2B only).
(D) 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

![Diaphysis and Epiphyseal Plate](image)

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

1. Forehead bone

2. Cheek bone

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 stylloid process

17. B-Frontal

18. Four bones, containing paranasal sinuses

19. K-Sphenoid

20. E-Maxillae

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
10. For each statement that is true, insert T in the answer blank. For false statements, correct the underlined words by inserting the correct words in the answer blanks.

Membranous 1. When a bone forms from a fibrous membrane, the process is called endochondral ossification.

Osteoblasts 2. When trapped in lacunae, osteoblasts change into osteocytes.

Secondary 3. Large numbers of osteocytes are found in the inner periosteum layer.

Hyaline Cart. 4. Primary ossification centers appear in the epiphyses of a long bone.

Endosteal 5. Epiphyseal plates are made of spongy bone.

T 6. In appositional growth, bone reabsorption occurs on the periosteal surface.

7. “Maturation” of newly formed (noncalcified) bone matrix takes about 10 days.

11. Figure 5–3, A–C, shows lateral, inferior, and anterior views of the skull. Select different colors for the bones listed below and color the coding circles and corresponding bones in the figure. Complete the figure by labeling the bone markings indicated by leader lines.

- Frontal
- Parietal
- Mandible
- Maxilla
- Sphenoid
- Ethmoid
- Temporal
- Zygomatic
- Palatine
- Occipital
- Nasal
- Lacrimal
- Vomer

**Figure 5–3, A–C**

- Squamous Suture
- Frontal
- Temporal
- Lambdoid Suture
- External Acoustic Meatus
- Mastoid Process
- Occipital
- Styloid Process

A (skull lateral view)
12. An anterior view of the skull, showing the positions of the sinuses, is provided in Figure 5–4. 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? **Mucosa-lined, air-filled cavities in bone**

2. What purpose do they serve in the skull? **Lighten the skull and serve as resonance chambers for speech.**

3. Why are they so susceptible to infection? **Mucosa is continuous with that of nasal passages into which they drain.**
Vertebral Column

13. Using the key choices, correctly identify the vertebral parts/areas described as follows. Enter the appropriate term(s) or letter(s) in the spaces provided. Items may have more than one answer.

**Key Choices**

A. Body  
B. Intervertebral foramina  
C. Spinous process  
D. Superior articular process  
E. Transverse process  
F. Vertebral arch

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

14. The following statements provide distinguishing characteristics of the vertebrae 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. Items may have more than one answer.

**Key Choices**

A. Atlas  
B. Axis  
C. Cervical vertebra—typical  
D. Coccyx  
E. Lumbar vertebra  
F. Sacrum  
G. Thoracic vertebra

1. Type of vertebra(e) containing foramina in the transverse processes, through which the vertebral arteries ascend to reach the brain  
2. 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 coxal bone (hip bone) laterally  
5. Massive vertebrae; weight-sustaining  
6. Tail bone; 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.

KYPHOSIS 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.

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

FIBROCARTILAGE 3. SPINOUSNESS / FLEXIBILITY 4.

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.

A Atlas C1, B Cervical (typical)
C Thoracic
D Lumbar

Figure 5–5
17. Figure 5–6 is a lateral view of the vertebral column.
(A) Identify each numbered region of the column by listing in the numbered answer blanks (1–5) the region name first and then the specific vertebrae involved (for example, sacral region, $S_5$ to $S_5$).
(B) Identify the modified vertebrae indicated by numbers/letters 1A and 1B in Figure 5–6.
(C) Select different colors for each vertebral region and use them to color the coding circles and the corresponding regions.

1. CERVICAL $c_1-c_7$
2. THORACIC $T_1-T_{12}$
3. LUMBAR $L_1-L_{5}$
4. SACRUM, FUSED
5. COCCYX, FUSED

1A. Atlas, $C_1$
1B. Axis, $C_2$
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) vertebrae, 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

Bone: SCAPULA

Figure 5–8
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
25. Figure 5–11 is a diagram of the articulated pelvis.
(A) Identify the bones and bone markings indicated by leader lines on
the figure.
(B) Select different colors for the structures listed below and use them to
color the coding circles and the corresponding structures in the figure.
(C) Label the dashed line showing the dimensions of the true pelvis and that
showing the diameter of the false pelvis.
(D) Complete the illustration by labeling the following bone markings:
obturator foramen, iliac crest, anterior superior iliac spine, ischial spine, pubic
ramus, and pelvic brim.
(E) List three ways in which the female pelvis differs from the male pelvis
and insert your answers in the answer blanks.

- Coxa bone (hip bone)
- Sacrum
- Pubic symphysis
- Acetabulum

26. Circle the term that does not belong in each of the following groupings. Then,
fill in the answer blanks with the correct group name.

2. Skull Rib cage Vertebral column [Group: AXIAL SKELETON]
3. Ischium Scapula Ilium Pubis [Group: COXAL BONES]
27. Using the key choices, identify the bone names and markings, according to the descriptions that follow. Insert the appropriate key term(s) or letter(s) in the answer blanks. Items may have more than one answer.

**Key Choices**

<table>
<thead>
<tr>
<th>A. Acetabulum</th>
<th>I. Ilium</th>
<th>Q. Patella</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. Calcaneus</td>
<td>J. Ischial tuberosity</td>
<td>R. Pubic symphysis</td>
</tr>
<tr>
<td>C. Femur</td>
<td>K. Ischium</td>
<td>S. Pubis</td>
</tr>
<tr>
<td>D. Fibula</td>
<td>L. Lateral malleolus</td>
<td>T. Sacroiliac joint</td>
</tr>
<tr>
<td>E. Gluteal tuberosity</td>
<td>M. Lesser sciatic notch</td>
<td>U. Talus</td>
</tr>
<tr>
<td>F. Greater sciatic notch</td>
<td>N. Medial malleolus</td>
<td>V. Tarsals</td>
</tr>
<tr>
<td>G. Greater and lesser trochanters</td>
<td>O. Metatarsals</td>
<td>W. Tibia</td>
</tr>
<tr>
<td>H. Iliac crest</td>
<td>P. Obturator foramen</td>
<td>X. Tibial tuberosity</td>
</tr>
</tbody>
</table>

1. Fuse to form the coxal bone (hip bone)  
2. Receives the weight of the body when sitting  
3. Point where the coxal bones join anteriorly  
4. Upper margin of iliac bones  
5. Deep socket in the coxal bone (hip bone) that receives the head of the thigh bone  
6. Point where the axial skeleton attaches to the pelvic girdle  
7. Longest bone in body; articulates with the coxal bone  
8. Lateral bone of the leg  
9. Medial bone of the leg  
10. Bones forming the knee joint  
11. Point where the patellar ligament attaches  
12. Kneecap  
13. Shinbone  
14. Distal process on medial tibial surface  
15. Process forming the outer ankle  
16. Heel bone
17. Bones of the ankle
18. Bones forming the instep of the foot
19. Opening in a coxal bone (hip bone) formed by the pubic and ischial rami
20. Sites of muscle attachment on the proximal end of the femur
21. Tarsal bone that articulates with the tibia

28. For each of the following statements that is true, insert T in the answer blank. If any of the statements are false, correct the underlined term by inserting the correct term in the answer blank.

**PELVIC**
1. The pectoral girdle is formed by the articulation of the coxal bones (hip bones) and the sacrum.

**PHALANGES**
2. Bones present in both the hand and the foot are *carpals*.

**ACETABULUM**
3. The tough, fibrous connective tissue covering of a bone is the *periosteum*.

**SCIATIC**
4. The point of fusion of the three bones forming a coxal bone is the *glenoid cavity*.

**COXAL BONES (HIP BONES)**
5. The large nerve that must be avoided when giving injections into the buttock muscles is the *femoral* nerve.

**FEMUR**
6. The long bones of a fetus are constructed of *hyaline* cartilage.

**KYPHOSIS**
7. Bones that provide the most protection to the abdominal viscera are the *ribs*.

**FEMUR**
8. The largest foramen in the skull is the *foramen magnum*.

**FEMUR**
9. The intercondylar fossa, greater trochanter, and gluteal tuberosity are all bone markings of the *humerus*.

**KYPHOSIS**
10. The first major event of fracture healing is *hematoma formation*.

11. An exaggerated thoracic curvature known as "dowager's hump" is an abnormal condition called *scoliosis*.
29. The bones of the thigh and the leg are shown in Figure 5–12.
(A) 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.
(B) 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
  - Lesser trochanter
  - Greater trochanter

- Tibia
  - Anterior border of tibia
  - Intercondylar eminence
  - Medial malleolus
  - Tibial tuberosity

- Fibula
  - Head of fibula
  - Lateral malleolus

![Diagram of thigh and leg bones]
30. Figure 5–13 is a diagram of the articulated skeleton in anatomical position. 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

![Image of the articulated skeleton with labeled bones]

Figure 5–13
31. Using the key choices, identify the fracture (fx) types shown in Figure 5–14 and the fracture types and treatments described below. Enter the appropriate key letter or term in each answer blank.

**Key Choices**

A. Closed reduction
B. Compression fracture
C. Compound fracture
D. Depressed fracture
E. Greenstick fracture
F. Open reduction
G. Simple fracture
H. Spiral fracture

1. Bone broken cleanly; ends do not penetrate the skin

2. Nonsurgical realignment of broken bone ends and splinting of bone

3. A break common in children; bone splinters, but break is incomplete

4. A fracture in which the bone is crushed; common in the vertebral column

5. A fracture in which the bone ends penetrate through the skin surface

6. Surgical realignment of broken bone ends

7. A result of twisting forces

*Figure 5–14*
32. For each of the following statements that is true about bone breakage and the repair process, insert T in the answer blank. For false statements, correct the underlined terms by inserting the correct term in the answer blank.

1. A **hematoma** usually forms at a fracture site.
2. Deprived of nutrition, **osteocytes** at the fracture site die.
3. Nonbony debris at the fracture site is removed by **osteoclasts**.
4. Growth of a new capillary supply into the region produces **granulation tissue**.
5. Osteoblasts from the **medullary cavity** migrate to the fracture site.
6. The **fibrocartilage callus** is the first repair mass to splint the broken bone.
7. The bony callus is initially composed of **compact bone**.

**JOINTS**

33. Figure 5–15 shows the structure of a typical diarthrotic joint. Select different colors to identify each of the following areas and use them to color the coding circles and the corresponding structures on the figure. Then, complete the statements below the figure.

- Articular cartilage of bone ends
- Fibrous capsule
- Synovial membrane
- Joint cavity

![Figure 5–15](image)

1. **Synovial fluid**
   - The lubricant that minimizes friction and abrasion of joint surfaces is **(1)**.
2. **Articular cartilage**
   - The resilient substance that keeps bone ends from crushing when compressed is **(2)**.
3. **Ligaments**
   - **(3)**, which reinforce the fibrous capsule, help to prevent dislocation of the joint.
34. For each joint described below, select an answer from Key A. Then, classify the joint further by making a choice from Key B when applicable. Items may have more than one answer.

Key Choices

Key A:  
A. Cartilaginous  
B. Fibrous  
C. Synovial

Key B:  
1. Synchondrosis (epiphyseal disc)  
2. Suture  
3. Symphysis

A, B  
1. Has amphiarthrotic and synarthrotic examples

C  
2. Fibrous capsule lined with synovial membrane surrounding a joint cavity

B & 2  
3. Bone regions united by fibrous connective tissue

B & 2  
4. Joints between skull bones

C  
5. Joint between the atlas and axis

C  
6. Hip, elbow, and knee

C  
7. All examples are diarthroses

A & 3  
8. Pubic symphysis

C  
9. All reinforced by ligaments

B & 2  
10. Joint providing the most protection to underlying structures

C  
11. Often contains a fluid-filled cushion

A & 3  
12. Child's long-bone growth plate made of hyaline cartilage

C  
13. Most joints of the limbs

C  
14. Often associated with bursae

C  
15. Have the greatest mobility

35. Which structural joint type is not commonly found in the axial skeleton and why not?

Synovial joints, which are diarthroses or freely movable joints, are the axial skeleton supports and protects internal organs; thus, strength is more important than mobility for joints of the axial skeleton.
38. Complete the following statements concerning fetal and infant skeletal development. Insert the missing words in the answer blanks.

Fontanels 1. “Soft spots," or membranous joints called \(1\) in the fetal skull, allow the skull to be \(2\) slightly when in the birth canal. They also allow for continued brain \(3\) during the later months of fetal development and early infancy. Eventually these soft spots are replaced by immovable joints called \(4\).

Compressed 2.

Growth 3.

Sutures 4.

Thoracic 5.

Sacral 6.

Primary 7.

Cervical 8.

Lumbar 9.

The two spinal curvatures well-developed at birth are the \(5\) and \(6\) curvatures. Because they are present at birth, they are called \(7\) curvatures. The secondary curvatures develop as the baby matures. The \(8\) curvature develops as the baby begins to lift his or her head. The \(9\) curvature matures when the baby begins to walk or assume the upright posture.

39. Where necessary, complete statements by inserting the missing words in the answer blanks.

Limber 1. For this journey, you are miniaturized and injected into the interior of the largest and longest bone of your host's body, the \(1\). Once inside this bone, you look around and find yourself examining the stalagmite- and stalactite-like structures that surround you. Although you feel as if you are in an underground cavern, you know that it has to be bone. Because the texture is so full of holes, it obviously is \(2\) bone. Although the arrangement of these bony spars seems to be haphazard, as if someone randomly dropped straws, they are precisely arranged to resist points of \(3\). All about you is frantic, hurried activity. Cells are dividing rapidly, nuclei are being ejected, and disc-like cells are appearing. You decide that these disc-like cells are \(4\) and that this is the \(5\) cavity. As you explore further, strolling along the edge of the cavity, you spot many tunnels leading into the solid bony area on which you are walking. Walking into one of these drainpipe-like openings, you notice that it contains a glistening white ropelike structure (a \(6\), no doubt) and blood vessels running the length of the tube. You eventually come to a point in the channel where the
Homeostatic Imbalances of Bones and Joints

36. For each of the following statements that is true, enter T in the answer blank. For each false statement, correct the underlined words by writing the correct words in the answer blank.

1. In a **sprain**, the ligaments reinforcing a joint are excessively stretched or torn.

2. Age-related erosion of articular cartilages and formation of painful bony spurs are characteristic of **gouty arthritis**.

3. **Chronic** arthritis usually results from bacterial invasion.

4. Healing of a partially torn ligament is slow because its hundreds of fibrous strands are poorly **aligned**.

5. **Rheumatoid arthritis** is an autoimmune disease.

6. High levels of uric acid in the blood may lead to **rheumatoid arthritis**.

7. A "soft" bone condition in children, usually caused by a lack of calcium or vitamin D in the diet, is called **osteomyelitis**.

8. Atrophy and thinning of bone owing to hormonal changes or inactivity (generally in the elderly) is called **osteoporosis**.

DEVELOPMENTAL ASPECTS OF THE SKELETON

37. Using the key choices, identify the body systems that relate to bone tissue viability. Enter the appropriate key term or letter in the answer blanks.

**Key Choices**

A. Endocrine  
B. Integumentary  
C. Muscular  
D. Nervous  
E. Urinary

1. Conveys the sense of pain in bone and joints

2. Activates vitamin D for proper calcium usage

3. Regulates uptake and release of calcium by bones

4. Increases bone strength and viability by pulling action

5. Influences skeleton proportions and adolescent growth of long bones

6. Provides vitamin D for proper calcium absorption