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## Skeletal System: Introduction and the Axial Skeleton

### I. Organization of the Skeletal System

 *Concept:* The axial and appendicular components of the skeletal system of an adult human consist of 206 individual bones arranged to form a strong, flexible body framework.


#### A. Multiple Choice Questions

- \_\_\_ 1. Which of the following account(s) for variance in the number of bones?  
(a) age (c) sex  
(b) heredity (d) both a and b
- \_\_\_ 2. Bones that form in tendons in response to stress are called  
(a) cartilaginous bones. (c) latent bones.  
(b) sesamoid bones. (d) spongy bones.
- \_\_\_ 3. Which structures are *not* a part of the axial skeleton?  
(a) auditory ossicles (c) ossa coxae  
(b) ribs (d) both b and c
- \_\_\_ 4. Which structure is *not* a part of the appendicular skeleton?  
(a) vertebral column (c) clavicle  
(b) patella (d) femur

#### B. True–False Questions

- \_\_\_ 1. There are fewer bones in an infant than there are in an adult.
- \_\_\_ 2. Only a few people have sesamoid bones.
- \_\_\_ 3. The hyoid bone is a sutural bone found in all people.
- \_\_\_ 4. The pectoral girdle is not a complete girdle because it lacks an anterior attachment to the axial skeleton.

### II. Functions of the Skeletal System

 *Concept:* The bones of the skeleton perform the mechanical functions of support, protection, and leverage for body movement and the metabolic functions of hemopoiesis and mineral storage.

#### A. Multiple Choice Questions

- \_\_\_ 1. Which is *not* a function of the skeletal system?  
(a) support (c) mineral storage  
(b) hemopoiesis (d) coordination

- \_\_\_ 2. Which is (are) *not* protected by the skeletal system?  
 (a) liver (c) muscles  
 (b) heart (d) central nervous system
- \_\_\_ 3. Bone is primarily composed of  
 (a) phosphorus. (c) magnesium.  
 (b) calcium. (d) both a and b.
- \_\_\_ 4. In function, the skeletal system is most closely associated with  
 (a) the muscular system. (c) the nervous system.  
 (b) the mineral system. (d) the urinary system.

### B. True–False Questions

- \_\_\_ 1. Bone marrow is responsible for hemopoiesis in the infant.
- \_\_\_ 2. The inorganic components of calcium and phosphorus give strength to bone.
- \_\_\_ 3. Living bone is inert material that is hard and dry.
- \_\_\_ 4. The skeletal system supports and protects several of the other body systems.

### III. Bone Structure

☞ *Concept:* Each bone has a characteristic shape and diagnostic surface features that indicate its functional relationship to other bones, muscles, and to the body structure as a whole.

#### A. Multiple Choice Questions

- \_\_\_ 1. Which is *not* one of the classifications of bones based on shape?  
 (a) long bones (c) thick bones  
 (b) flat bones (d) short bones
- \_\_\_ 2. The type of bone that most commonly functions as a lever is  
 (a) an irregular bone. (d) a short bone.  
 (b) a thick bone. (e) a sesamoid bone.  
 (c) a long bone.
- \_\_\_ 3. A facet is described as  
 (a) a marked bony prominence.  
 (b) a sharp, slender process.  
 (c) a flattened or shallow articulating surface.  
 (d) a projection above a condyle.
- \_\_\_ 4. A small pit or depression on a bone is referred to as  
 (a) a fossa. (c) a fovea.  
 (b) a fissure. (d) a meatus.
- \_\_\_ 5. Red bone marrow within certain long bones is in contact with  
 (a) the articular cartilage. (c) the epiphyseal plate.  
 (b) the endosteum. (d) the periosteum.

## B. True–False Questions

- \_\_\_ 1. Diploe is a layer of spongy bone between the hard outer and inner bone layers of the cranium.
- \_\_\_ 2. Individual bones are considered organs because there are many bones that make up the skeletal system.
- \_\_\_ 3. The periosteum is responsible for the diametric growth of the bone.
- \_\_\_ 4. An epicondyle is a major articulating surface.

## IV. Bone Tissue

☞ *Concept:* Bone tissue is composed of several types of bone cells embedded in a matrix of ground substance, inorganic salts (calcium and phosphorus), and collagenous fibers. Bone cells and ground substance give bone flexibility and strength; the inorganic salts give it hardness.

### A. Multiple Choice Questions

- \_\_\_ 1. Large bone cells that enzymatically break down bone tissue and that play an important role in bone growth, remodeling, and healing are known as
  - (a) osteogenic cells.
  - (b) osteoblasts.
  - (c) osteocytes.
  - (d) osteoclasts.
  - (e) bone-lining cells.
- \_\_\_ 2. The bone cells that are thought to regulate the movement of calcium and phosphate into and out of bone matrix are known as
  - (a) osteogenic cells.
  - (b) osteoblasts.
  - (c) osteocytes.
  - (d) osteoclasts.
  - (e) bone-lining cells.
- \_\_\_ 3. Osteocytes within compact bone tissue are located in minute capsules, or spaces, known as
  - (a) lacunae.
  - (b) osteons.
  - (c) lamellae.
  - (d) trabeculae.
  - (e) sinuses.
- \_\_\_ 4. In compact bone, the matrix is laid down in concentric rings called
  - (a) osteons.
  - (b) lamellae.
  - (c) canaliculi.
  - (d) trabeculae.
  - (e) osteons.
- \_\_\_ 5. \_\_\_\_\_ builds up bone, while \_\_\_\_\_ breaks down bone.
  - (a) Meatus/marrow
  - (b) Osteoblast activity/osteoclast activity
  - (c) Epiphysis/diaphysis
  - (d) Diaphysis/epiphysis
- \_\_\_ 6. Calcification is the process of
  - (a) ossification.
  - (b) osteoporosis.
  - (c) growth.
  - (d) mitosis.

## B. True–False Questions

- \_\_\_ 1. Trabeculae are spikes of bone tissue that give strength to compact bone.
- \_\_\_ 2. Osteocytes are mature bone cells that maintain bone tissue by secreting enzymes and influencing bone mineral content.
- \_\_\_ 3. Nutrients reach the osteocytes within lacunae by passing through canaliculi.
- \_\_\_ 4. The nutrient vessels of bone tissue pass through both perforating canals and central canals.

## V. Bone Growth

☞ *Concept:* The development of bone from embryo to adult depends on the orderly processes of cell division, growth, and ongoing remodeling. Bone growth is influenced by genetics, hormones, and nutrition.

### A. Completion Questions

- 1. \_\_\_\_\_ is the process by which minerals are deposited in the matrix of cartilaginous bone tissue.
- 2. \_\_\_\_\_ is the organic component of bone, secreted by osteoblasts.
- 3. Spongy bone develops at the \_\_\_\_\_ centers.
- 4. A(n) \_\_\_\_\_ consists of five histological zones.
- 5. The \_\_\_\_\_ is a region of transformation from cartilage to bone tissue.

### B. True–False Questions

- \_\_\_ 1. Most bones develop first as a cartilaginous model, and then the cartilage is gradually replaced by bone.
- \_\_\_ 2. Once a bone has formed through the process of ossification, its shape and the size of its processes are fixed for life and are not subject to change.
- \_\_\_ 3. Linear bone growth (lengthwise) is accomplished at the epiphyseal plates.
- \_\_\_ 4. Osteoclasts secrete osteoid at the primary ossification centers.
- \_\_\_ 5. The periosteal bud, consisting of osteoblasts and blood vessels, is important in the development of the primary ossification center.

## VI. Skull

☞ *Concept:* The human skull, consisting of 8 cranial and 14 facial bones, contains several cavities that house the brain and sensory organs. Each bone of the skull articulates with the adjacent bones and has diagnostic and functional processes, surface features, and foramina.

## A. Multiple Choice Questions

- \_\_\_ 1. The fontanels permit  
(a) rapid brain growth. (c) molding during parturition.  
(b) passage of heat. (d) both a and c.
- \_\_\_ 2. Which is *not* one of the six fontanels?  
(a) lateral (c) frontal  
(b) posterior (d) none of the above
- \_\_\_ 3. Which is *not* a bone forming the orbit?  
(a) frontal bone (c) maxilla  
(b) zygomatic bone (d) occipital bone
- \_\_\_ 4. The mastoid process is a bony extension of  
(a) the occipital bone. (d) the zygomatic bone.  
(b) the parietal bone. (e) the temporal bone.  
(c) the sphenoid bone.
- \_\_\_ 5. The sella turcica, supporting the pituitary gland, is part of  
(a) the frontal bone. (c) the nasal bone.  
(b) the sphenoid bone. (d) the ethmoid bone.
- \_\_\_ 6. Which statement explains why facial bones are not classified as cranial bones?  
(a) Facial bones do not come in contact with the brain.  
(b) They are lighter in weight than cranial bones.  
(c) The cranial bones have cavities.  
(d) None of the above.
- \_\_\_ 7. Which is *not* a facial bone?  
(a) zygomatic bone (c) vomer  
(b) lacrimal bone (d) none of the above (all are facial bones)

## B. True–False Questions

- \_\_\_ 1. The cranial cavity is the only cavity in the skull.
- \_\_\_ 2. The foramen magnum is the large hole in the cranium through which the spinal cord passes.
- \_\_\_ 3. The frontal, sphenoid, ethmoid, and occipital bones are the only unpaired bones of the skull.
- \_\_\_ 4. There are more facial bones than cranial bones.
- \_\_\_ 5. The lower jaw is not considered one of the cranial or facial bones.

## VII. Vertebral Column

☞ *Concept:* The vertebral column consists of a series of irregular bones called vertebrae, separated from each other by fibrocartilaginous intervertebral discs. Vertebrae enclose and protect the spinal cord, support the skull and allow for its movement, articulate with the rib cage, and provide for the attachment of trunk muscles. The intervertebral discs lend flexibility to the vertebral column and absorb vertical shock.

## A. Multiple Choice Questions

- \_\_\_\_\_ 1. The functions of the vertebral column do *not* include  
(a) protection of the spinal cord.  
(b) support for the head.  
(c) muscle attachment.  
(d) reflex actions.
- \_\_\_\_\_ 2. Which of the following is *not* one of the four curvatures of the vertebral column?  
(a) brachial curve (c) cervical curve  
(b) thoracic curve (d) lumbar curve
- \_\_\_\_\_ 3. The processes that limit the twisting of the vertebral column are  
(a) spinous processes. (c) transverse processes.  
(b) lateral processes. (d) articular processes.
- \_\_\_\_\_ 4. A structural feature of a typical cervical vertebra is  
(a) a transverse foramen. (c) a long spinous process.  
(b) a dens. (d) a fovea.

## B. True–False Questions

- \_\_\_\_\_ 1. The cervical and lumbar curves are called primary curves because they retain the shape of the fetus.
- \_\_\_\_\_ 2. There are more fused vertebrae than unfused vertebrae.
- \_\_\_\_\_ 3. The cervical vertebrae are the smallest vertebrae.
- \_\_\_\_\_ 4. The coccyx can be formed from either four or five vertebrae.

## VIII. Rib Cage

☞ *Concept:* The cone-shaped, flexible rib cage consists of the thoracic vertebrae, 12 paired ribs, costal cartilages, and the sternum. It encloses and protects the thoracic viscera and is directly involved in the mechanics of breathing.

## A. Multiple Choice Questions

- \_\_\_\_\_ 1. Which of the following is (are) *not* considered a part of the rib cage?  
(a) clavicles (c) sternum  
(b) false ribs (d) costal cartilages
- \_\_\_\_\_ 2. The three components of the sternum, listed from superior to inferior in position, are  
(a) the xiphoid process, sternal angle, and costal notch.  
(b) the manubrium, body, and xiphoid process.  
(c) the jugular notch, clavicular notch, and costal notch.  
(d) the body, manubrium, and clavicular notch.
- \_\_\_\_\_ 3. The part of the sternum that attaches to the greatest number of ribs is  
(a) the manubrium. (c) the xiphoid process.  
(b) the body. (d) none of the above (all attach to the same number).
- \_\_\_\_\_ 4. Certain structures are common to all ribs; for example,  
(a) a tubercle. (c) a neck.  
(b) a head. (d) both b and c.

## B. True–False Questions

- \_\_\_ 1. The rib cage is compressed anteroposteriorly.
- \_\_\_ 2. Some of the ribs are important in the production of blood cells.
- \_\_\_ 3. There is only one jugular notch.
- \_\_\_ 4. Since they are composed of cartilage, ribs 8, 9, and 10 are called false ribs.

## IX. Developmental Exposition of the Axial Skeleton

### A. True–False Questions

- \_\_\_ 1. Ossification continues from the fourth week of prenatal development to age 25 or 30.
- \_\_\_ 2. Portions of the notochord persist in the formation of the intervertebral discs.
- \_\_\_ 3. Most bone is formed directly, without first going through a cartilage stage.

### B. Completion Questions

- 1. Ossification begins at about the \_\_\_\_\_ week of embryonic development but cannot be readily observed until about the \_\_\_\_\_ week.
- 2. Bone tissue develops from specialized migratory mesodermal cells known as \_\_\_\_\_.
- 3. For the most part, the embryonic skeleton is initially composed of \_\_\_\_\_ cartilage.
- 4. Bone that forms directly, without going through a cartilage stage, is referred to as \_\_\_\_\_ bone.
- 5. \_\_\_\_\_ bones, located in tendons, form by intramembranous ossification.

## X. Clinical Considerations

### A. Multiple Choice Questions

- \_\_\_ 1. An abnormal condition in a child due to a lack of vitamin D is
  - (a) osteomalacia.
  - (b) rickets.
  - (c) acromegaly.
  - (d) gigantism.
- \_\_\_ 2. Osteoporosis, the disorder characterized by demineralization of the bone, is most common in which group?
  - (a) postmenopausal women
  - (b) elderly men
  - (c) children
  - (d) adults in general
- \_\_\_ 3. In an adult, hypersecretion of growth hormone by the anterior pituitary may result in
  - (a) Paget's disease.
  - (b) osteoporosis.
  - (c) acromegaly.
  - (d) osteomalacia.
- \_\_\_ 4. The most virulent type of bone cancer, which frequently metastasizes through the blood to the lungs, is
  - (a) osteblastoma.
  - (b) osteoma.
  - (c) osteogenic sarcoma.
  - (d) none of the above (bone cancer is not virulent).

## B. True–False Questions

- \_\_\_ 1. Rickets and osteomalacia are bone disorders caused by insufficient vitamin D.
- \_\_\_ 2. An osteoma is a benign bone tumor.
- \_\_\_ 3. Adult bone tissue is resistant to malignant cancer because it no longer mitotically active.
- \_\_\_ 4. Orthopedics is a branch of medicine concerned with the prevention or correction of injuries or disorders involving the musculoskeletal system.

## XI. Chapter Review

### A. Completion Questions

1. For convenience of study, the skeleton is divided into \_\_\_\_\_ and \_\_\_\_\_ portions.
2. A diet deficient in vitamin D causes the blood level to fall below that necessary for calcification, resulting in a condition known as \_\_\_\_\_.
3. \_\_\_\_\_ is the production of blood cells within the red bone marrow.
4. Some mesenchymal cells develop directly into bone in the process referred to as \_\_\_\_\_ ossification.
5. The \_\_\_\_\_ is the gelatinous center of an intervertebral disc.
6. The large, rounded articulating knobs that permit movement at the joints of many long bones are referred to as \_\_\_\_\_.
7. The medullary cavity within the diaphysis of a long bone is lined with a thin layer of connective tissue called the \_\_\_\_\_ and contains \_\_\_\_\_, so named because it consists primarily of fat cells.
8. Specialized bone cells called \_\_\_\_\_ enzymatically destroy bone tissue, permitting bone resorption.
9. A radiograph may also be referred to as a \_\_\_\_\_ in honor of the German physicist who developed the photographic technique using X rays.
10. The \_\_\_\_\_ are fragile, scroll-like bones that project medially into the nasal cavity.
11. Projections from the body of the hyoid bone are collectively referred to as \_\_\_\_\_.
12. The anterior \_\_\_\_\_ is the large soft spot on the anteromedial portion of an infant's skull.
13. \_\_\_\_\_ is a congenital defect of the vertebral column resulting from a failure of the laminae of the vertebrae to fuse, leaving the spinal cord exposed.
14. \_\_\_\_\_ is a bone disorder common among the elderly and characterized by marked demineralization, which weakens bone.



15. The \_\_\_\_\_ in the roof of the mouth is formed from processes of the maxillae and palatine bones.
16. Osteocytes within osteons are located within spaces called \_\_\_\_\_.
17. \_\_\_\_\_ are primordial (developing) bone cells that secrete osteoid, the organic component of bone.

## B. Matching Questions

Match the bone with its diagnostic feature.

- |                          |                          |
|--------------------------|--------------------------|
| _____ 1. sphenoid bone   | (a) supraorbital foramen |
| _____ 2. mandible        | (b) mental foramen       |
| _____ 3. maxilla         | (c) auricular surface    |
| _____ 4. ethmoid bone    | (d) mastoid process      |
| _____ 5. sacrum          | (e) infraorbital foramen |
| _____ 6. sternum         | (f) crista galli         |
| _____ 7. rib             | (g) pterygoid process    |
| _____ 8. frontal bone    | (h) transverse process   |
| _____ 9. lumbar vertebra | (i) tubercle             |
| _____ 10. temporal bone  | (j) costal notch         |