

# Chapter Six Review

## 6.1 The Functions of the Skeletal System

The major functions of the bones are body support, facilitation of movement, protection of internal organs, storage of minerals and fat, and hematopoiesis. Together, the muscular system and skeletal system are known as the musculoskeletal system.

## 6.2 Bone Classification

Bones can be classified according to their shapes. Long bones, such as the femur, are longer than they are wide. Short bones, such as the carpals, are approximately equal in length, width, and thickness. Flat bones are thin, but are often curved, such as the ribs. Irregular bones such as those of the face have no characteristic shape. Sesamoid bones, such as the patellae, are small and round, and are located in tendons.

## 6.3 Bone Structure

A hollow medullary cavity filled with yellow marrow runs the length of the diaphysis of a long bone. The walls of the diaphysis are compact bone. The epiphyses, which are wider sections at each end of a long bone, are filled with spongy bone and red marrow. The epiphyseal plate, a layer of hyaline cartilage, is replaced by osseous tissue as the organ grows in length. The medullary cavity has a delicate membranous lining called the endosteum. The outer surface of bone, except in regions covered with articular cartilage, is covered with a fibrous membrane called the periosteum. Flat bones consist of two layers of compact bone surrounding a layer of spongy bone. Bone markings depend on the function and location of bones. Articulations are places where two bones meet. Projections stick out from the surface of the bone and provide attachment points for tendons and ligaments. Holes are openings or depressions in the bones. Bone matrix consists of collagen fibers and organic ground substance, primarily hydroxyapatite formed from calcium salts. Osteogenic cells develop into osteoblasts. Osteoblasts are cells that make new bone. They become osteocytes, the cells of mature bone, when they get trapped in the matrix. Osteoclasts engage in bone resorption. Compact bone is dense and composed of osteons, while spongy bone is less dense and made up of trabeculae. Blood vessels and nerves enter the bone through the nutrient foramina to nourish and innervate bones.

## 6.4 Bone Formation and Development

All bone formation is a replacement process. Embryos develop a cartilaginous skeleton and various membranes. During development, these are replaced by bone during the ossification process. In intramembranous ossification, bone develops directly from sheets of mesenchymal connective tissue. In endochondral ossification, bone develops by replacing hyaline cartilage. Activity in the epiphyseal plate enables bones to grow in length. Modeling allows bones to grow in diameter. Remodeling occurs as bone is resorbed and replaced by new bone. Osteogenesis imperfecta is a genetic disease in which collagen production is altered, resulting in fragile, brittle bones.

## 6.5 Fractures: Bone Repair

Fractured bones may be repaired by closed reduction or open reduction. Fractures are classified by their complexity, location, and other features. Common types of fractures are transverse, oblique, spiral, comminuted, impacted, greenstick, open (or compound), and closed (or simple). Healing of fractures begins with the formation of a hematoma, followed by internal and external calli. Osteoclasts resorb dead bone, while osteoblasts create new bone that replaces the cartilage in the calli. The calli eventually unite, remodeling occurs, and healing is complete.

## 6.6 Exercise, Nutrition, Hormones, and Bone Tissue

Mechanical stress stimulates the deposition of mineral salts and collagen fibers within bones. Calcium, the predominant mineral in bone, cannot be absorbed from the small intestine if vitamin D is lacking. Vitamin K supports bone mineralization and may have a synergistic role with vitamin D. Magnesium and fluoride, as structural elements, play a supporting role in bone health. Omega-3 fatty acids reduce inflammation and may promote production of new osseous tissue. Growth hormone increases the length of long bones, enhances mineralization, and improves bone density. Thyroxine stimulates bone growth and promotes the synthesis of bone matrix. The sex hormones (estrogen in women; testosterone in men) promote osteoblastic activity and the production of bone matrix, are responsible for the adolescent growth spurt, and promote closure of the epiphyseal plates. Osteoporosis is a disease characterized by decreased bone mass that is common in aging adults. Calcitriol stimulates the digestive tract to absorb calcium and phosphate. Parathyroid hormone (PTH)

stimulates osteoclast proliferation and resorption of bone by osteoclasts. Vitamin D plays a synergistic role with PTH in stimulating the osteoclasts. Additional functions of PTH include promoting reabsorption of calcium by kidney tubules and indirectly increasing calcium absorption from the small intestine. Calcitonin inhibits osteoclast activity and stimulates calcium uptake by bones.

### **6.7 Calcium Homeostasis: Interactions of the Skeletal System and Other Organ Systems**

Calcium homeostasis, i.e., maintaining a blood calcium level of about 10 mg/dL, is critical for normal body functions. Hypocalcemia can result in problems with blood coagulation, muscle contraction, nerve functioning, and bone strength. Hypercalcemia can result in lethargy, sluggish reflexes, constipation and loss of appetite, confusion, and coma. Calcium homeostasis is controlled by PTH, vitamin D, and calcitonin and the interactions of the skeletal, endocrine, digestive, and urinary systems.

1. Which function of the skeletal system would be especially important if you were in a car accident?
  - a. storage of minerals
  - b. protection of internal organs
  - c. facilitation of movement
  - d. fat storage
  
2. Bone tissue can be described as \_\_\_\_\_.
  - a. dead calcified tissue
  - b. cartilage
  - c. the skeletal system
  - d. dense, hard connective tissue
  
3. Without red marrow, bones would not be able to \_\_\_\_\_.
  - a. store phosphate
  - b. store calcium
  - c. make blood cells
  - d. move like levers
  
4. Yellow marrow has been identified as \_\_\_\_\_.
  - a. an area of fat storage
  - b. a point of attachment for muscles
  - c. the hard portion of bone
  - d. the cause of kyphosis
  
5. Which of the following can be found in areas of movement?
  - a. hematopoiesis
  - b. cartilage
  - c. yellow marrow
  - d. red marrow
  
6. The skeletal system is made of \_\_\_\_\_.
  - a. muscles and tendons
  - b. bones and cartilage
  - c. vitreous humor
  - d. minerals and fat
  
7. Most of the bones of the arms and hands are long bones; however, the bones in the wrist are categorized as \_\_\_\_\_.
  - a. flat bones
  - b. short bones
  - c. sesamoid bones
  - d. irregular bones
  
8. Sesamoid bones are found embedded in \_\_\_\_\_.
  - a. joints
  - b. muscles
  - c. ligaments
  - d. tendons

9. Bones that surround the spinal cord are classified as \_\_\_\_\_ bones.

- a. irregular
- b. sesamoid
- c. flat
- d. short

10. Which category of bone is among the most numerous in the skeleton?

- a. long bone
- b. sesamoid bone
- c. short bone
- d. flat bone

11. Long bones enable body movement by acting as a \_\_\_\_\_.

- a. counterweight
- b. resistive force
- c. lever
- d. fulcrum

12. Which of the following occurs in the spongy bone of the epiphysis?

- a. bone growth
- b. bone remodeling
- c. hematopoiesis
- d. shock absorption

13. The diaphysis contains \_\_\_\_\_.

- a. the metaphysis
- b. fat stores
- c. spongy bone
- d. compact bone

14. The fibrous membrane covering the outer surface of the bone is the \_\_\_\_\_.

- a. periosteum
- b. epiphysis
- c. endosteum
- d. diaphysis

15. Which of the following are incapable of undergoing mitosis?

- a. osteoblasts and osteoclasts
- b. osteocytes and osteoclasts
- c. osteoblasts and osteocytes
- d. osteogenic cells and osteoclasts

16. Which cells do not originate from osteogenic cells?

- a. osteoblasts
- b. osteoclasts
- c. osteocytes
- d. osteoprogenitor cells

17. Which of the following are found in compact bone and cancellous bone?

- a. Haversian systems
- b. Haversian canals
- c. lamellae
- d. lacunae

18. Which of the following are only found in cancellous bone?

- a. canaliculi
- b. Volkmann's canals
- c. trabeculae
- d. calcium salts

19. The area of a bone where the nutrient foramen passes forms what kind of bone marking?

- a. a hole
- b. a facet
- c. a canal
- d. a fissure

20. Why is cartilage slow to heal?

- a. because it eventually develops into bone
- b. because it is semi-solid and flexible
- c. because it does not have a blood supply
- d. because endochondral ossification replaces all cartilage with bone

21. Why are osteocytes spread out in bone tissue?

- a. They develop from mesenchymal cells.
- b. They are surrounded by osteoid.
- c. They travel through the capillaries.
- d. Formation of osteoid spreads out the osteoblasts that formed the ossification centers.

22. In endochondral ossification, what happens to the chondrocytes?

- a. They develop into osteocytes.
- b. They die in the calcified matrix that surrounds them and form the medullary cavity.
- c. They grow and form the periosteum.
- d. They group together to form the primary ossification center.

23. Which of the following bones is (are) formed by intramembranous ossification?

- a. the metatarsals
- b. the femur
- c. the ribs
- d. the flat bones of the cranium

24. Bones grow in length due to activity in the \_\_\_\_\_.

- a. epiphyseal plate
- b. perichondrium
- c. periosteum
- d. medullary cavity

25. Bones grow in diameter due to bone formation \_\_\_\_\_.

- a. in the medullary cavity
- b. beneath the periosteum
- c. in the epiphyseal plate
- d. within the metaphysis

26. Which of the following represents the correct sequence of zones in the epiphyseal plate?

- a. proliferation, reserved, maturation, calcification
- b. maturation, proliferation, reserved, calcification
- c. calcification, maturation, proliferation, reserved
- d. calcification, reserved, proliferation, maturation

27. A fracture can be both \_\_\_\_\_.

- a. open and closed
- b. open and transverse
- c. transverse and greenstick
- d. greenstick and comminuted

28. How can a fractured diaphysis release fat globules into the bloodstream?

- a. The bone pierces fat stores in the skin.
- b. The yellow marrow in the diaphysis is exposed and damaged.
- c. The injury triggers the body to release fat from healthy bones.
- d. The red marrow in the fractured bone releases fat to heal the fracture.

29. In a compound fracture, \_\_\_\_\_.

- a. the break occurs at an angle to the bone
- b. the broken bone does not tear the skin
- c. one fragment of broken bone is compressed into the other
- d. broken bone pierces the skin

30. The internal and external calli are replaced by \_\_\_\_\_.

- a. hyaline cartilage
- b. trabecular bone
- c. osteogenic cells
- d. osteoclasts

31. The first type of bone to form during fracture repair is \_\_\_\_\_ bone.

- a. compact
- b. lamellar
- c. spongy
- d. dense

32. Wolff's law, which describes the effect of mechanical forces in bone modeling/remodeling, would predict that \_\_\_\_\_

- a. a right-handed pitcher will have thicker bones in his right arm compared to his left.
- b. a right-handed cyclist will have thicker bones in her right leg compared to her left.
- c. a broken bone will heal thicker than it was before the fracture.
- d. a bed-ridden patient will have thicker bones than an athlete.

33. Calcium cannot be absorbed from the small intestine if \_\_\_\_\_ is lacking.

- a. vitamin D
- b. vitamin K
- c. calcitonin
- d. fluoride

34. Which one of the following foods is best for bone health?

- a. carrots
- b. liver
- c. leafy green vegetables
- d. oranges

35. Which of the following hormones are responsible for the adolescent growth spurt?

- a. estrogen and testosterone
- b. calcitonin and calcitriol
- c. growth hormone and parathyroid hormone
- d. thyroxine and progesterone

36. With respect to their direct effects on osseous tissue, which pair of hormones has actions that oppose each other?

- a. estrogen and testosterone
- b. calcitonin and calcitriol
- c. estrogen and progesterone
- d. calcitonin and parathyroid hormone

37. When calcium levels are too high or too low, which body system is primarily affected?

- a. skeletal system
- b. endocrine system
- c. digestive system
- d. nervous system

38. All of the following play a role in calcium homeostasis except

- a. thyroxine
- b. calcitonin
- c. parathyroid hormone
- d. vitamin D

39. Which of the following is most likely to be released when blood calcium levels are elevated?

- a. thyroxine
- b. calcitonin
- c. parathyroid hormone
- d. vitamin D