

Chapter 6: Skeletal System: Bones and Bone Tissue

I. Functions

A. List and describe the five major functions of the skeletal system:

1. _____

2. _____

3. _____

4. _____

5. _____

II. Cartilage

- A. What do chondroblasts do? _____
- B. When a chondroblast becomes surrounded by matrix it is called _____
- C. Perichondrium
 1. The outer layer is composed of _____
 2. The inner layer has _____
 3. Blood vessels penetrate _____
- D. Where is articular cartilage found? _____
- E. Describe appositional growth: _____
- F. Describe interstitial growth: _____

III. Bone Anatomy

A. Describe each of the four basic bone shapes:

1. Long bone _____
2. Short bone _____
3. Flat bone _____
4. Irregular bone _____

B. Structure of a Long Bone

1. The diaphysis is composed primarily of _____
2. Where is the diaphysis? _____
3. What is an epiphysis? _____
4. The epiphysis is composed primarily of _____ that is covered by a layer of _____ & at joints _____
5. What is the epiphyseal plate composed of? _____
6. Where is the epiphyseal plate located? _____
7. What occurs at the epiphyseal plate? _____
8. When the epiphyseal plate is ossified it is called _____
9. Inside the diaphysis is a large space called _____
10. Red marrow is the site of _____ while yellow marrow is _____
11. The outer surface of the bone is covered by the _____
 - a. The outer layer is composed of _____
 - b. The inner layer is composed of _____
12. How are tendons and ligaments attached to the bone? _____

13. The inside of the medullary cavity is lined by the _____
 - a. This membrane is composed of: _____

C. Structure of Flat, Short, and Irregular Bones

1. Flat bones have an interior _____ of _____ that is sandwiched between _____
2. Short and irregular bones have a surface layer of _____ that surrounds _____
3. Air filled spaces inside flat and irregular bones are called _____

- a. These spaces are lined by _____

IV. Bone Histology

A. Bone Matrix

1. Composed of 35% _____ & 65% _____
2. Hydroxyapatite is _____
3. Functionally collagen fibers in bone _____
4. Functionally the mineral matrix in bone _____

B. Bone Cells

1. Osteoblasts

- a. These cells produce _____ & _____
- b. In addition to various enzymes osteoblasts also form vesicles that accumulate _____ & _____
- c. All vesicles are released by _____
- d. Define ossification: _____

2. Osteocytes

- a. When does an osteoblast become an osteocyte? _____
- b. Osteocytes produce components needed to _____
- c. Osteocytes sit in a space called a _____
- d. The spaces that contain osteocyte cell processes are called _____
- e. Nutrients and gases pass through _____

3. Osteoclasts

- a. Describe an osteoclast _____
- b. Osteoclasts are responsible for _____

4. Origin of Bone Cells

- a. Osteoblasts are derived from _____
- b. Osteocytes are derived from _____
- c. Osteoclasts are derived from _____

C. Woven and Lamellar Bone

1. In woven bone collagen fibers are _____
2. When is woven bone formed? _____ & _____

3. Explain remodeling: _____
4. Lamellar bone is organized into _____ called _____
5. In lamellar bone the collagen fibers _____
6. How are osteocytes arranged in lamellar bone? _____

D. Cancellous and Compact Bone

1. Cancellous bone has _____ & _____
2. Compact bone has _____ & _____
3. Cancellous Bone
 - a. It consists of _____ called _____
 - b. The spaces are filled with _____ & _____
 - c. Trabeculae are oriented _____
4. Compact Bone
 - a. The lamellae are oriented around _____
 - b. Blood vessels that run parallel to the bone's long axis are contained within _____ or _____
 - c. The concentric lamellae _____
 - d. An osteon (haversian system) consists of _____

 1. If cut in cross section it resembles _____
 - e. Describe the three types of lamellae:
 1. Concentric _____
 2. Circumferential _____
 3. Interstitial _____
 - f. How do perforating (Volkmann's) canals differ from central (haversian) canals? _____

V. Bone Development

A. Intramembranous Ossification

1. Begins when mesenchymal cells in the membrane become _____
2. These cells specialize to become _____

3. The osteoblasts produce _____ that surrounds _____

 - a. This is a "center of ossification".
 4. This process forms many tiny _____ of _____
 5. The trabeculae enlarge as _____

 6. As the trabeculae join together they form _____
separated by _____
 7. Cells within the spaces specialize to form _____
 8. Cells surrounding the developing bone specialize & form _____
 9. An outer surface of compact bone is formed by _____
 10. The end product of intramembranous ossification:
 - a. Bones with outer _____ &
 - b. _____ centers
 11. Remodeling forms _____ bone and _____
- B. Endochondral Ossification**
1. Begins as _____ aggregate _____
 2. The cells become _____ & produce a _____
having the approximate shape of the future bone
 3. When surrounded by matrix the chondroblasts become _____
 4. The cartilage model is surrounded by _____
 5. Blood vessels penetrating the perichondrium cause _____
_____ to become _____
 6. When bone is being produced the perichondrium becomes _____
 7. The osteoblasts produce _____ on the surface of the cartilage
model forming a _____
 8. The cartilage continues to grow by _____ & _____
 9. Chondrocytes inside the cartilage model _____
 10. The matrix between becomes _____ with _____ &
is referred to as _____
 11. The chondrocytes then _____ leaving _____

12. What grows into the enlarged lacunae? _____
13. This results in osteoblasts forming _____, which changes the calcified matrix of the diaphysis into _____
- a. The area of bone formation in the diaphysis is called _____
14. As ossification proceeds:
- a. The cartilage model _____
- b. More perichondrium _____
- c. The bone collar _____
- d. Within the diaphysis _____
15. Remodeling converts _____ bone to _____ bone and _____
16. Osteoclasts _____
17. Cells within the medullary cavity _____
18. Secondary ossification centers appear _____
- a. What happens differently at secondary ossification centers compared to primary ossification centers? _____
19. Eventually all cartilage in the model is replaced by bone except:
- a. In the _____
- b. And on _____

VI. Bone Growth

- A. Occurs only by _____ growth
- B. Growth in Bone Length
1. Growth at the epiphyseal plate involves _____ of new _____ by _____ growth followed by _____ bone growth.
2. Describe the events in each of the four zones of the epiphyseal plate:
- a. Zone of resting cartilage _____
- _____
- _____
- a. Zone of proliferation _____
- _____

- _____
- a. Zone of hypertrophy _____
- _____
- _____
- a. Zone of calcification _____
- _____
- _____
3. What part of the bone is increasing in length? _____
4. The thickness of the epiphyseal plate stays the same because:
- a. Rate of _____ on the _____ side is
- b. Equal to _____ on the _____ side
5. When the epiphyseal plate stops growing and is ossified it is _____
- C. Growth at Articular Cartilage
1. Growth at the articular cartilage increases size of _____
2. How does this process differ from what occurs at the epiphyseal plate?
- _____
3. How long does the articular cartilage remain on the epiphyses? _____
- D. Growth in Bone Width
1. Bones increase in width due to _____ under _____
2. When growth in width is rapid:
- a. Osteoblasts lay down bone in _____
- with _____ between them
- b. Periosteum covers the ridges and grooves and one or more _____
- _____ of the periosteum lie _____
- c. The ridges increase in size eventually forming _____
- d. Since the periosteum of the tunnel is now lining bone it is a _____
- e. Concentric lamellae are formed by _____ of the _____
- f. Eventually this fills in the tunnel and forms an _____
3. When growth in width is slow:
- a. Circumferential lamellae are formed making the bone surface _____
- b. Remodeling breaks down the _____ & forms _____

E. Factors Affecting Bone Growth**1. Nutrition**

- a. What role does Vitamin D play in bone growth? _____
- b. What role does Vitamin C play in bone growth? _____

2. Hormones

- a. Growth hormone stimulates:
 1. _____ &
 2. _____
- b. Thyroid hormone is required for _____
- c. Estrogen and testosterone:
 1. Initially _____
 2. Also stimulate ossification of _____
- d. Why are females usually shorter than males? _____

VII. Bone Remodeling**A. Bone remodeling:**

1. Converts _____ bone to _____ bone
2. Is involved in _____
3. Changes in _____
4. Adjustment of bone to _____
5. Bone _____
6. _____ in the body

B. Remodeling causes the diameter of the medullary cavity to _____ as the bone increases in length and width.

1. What is the advantage to having a medullary cavity? _____

C. Remodeling is also involved in the formation of _____ in bone.**D. What do interstitial lamellae represent? _____**

VIII. Bone Repair

A. Hematoma Formation

1. A hematoma is _____
 - a. The blood usually forms a _____ that _____
2. What happens to the bone tissue adjacent to the fracture site? _____

B. Callus Formation

1. A callus is _____
 - a. Internal callus
 1. Forms between _____ & in the _____
 2. As the clot dissolves:
 - a. Macrophages _____
 - b. Osteoclasts _____
 - c. Fibroblasts produce _____
 3. A denser fibrous network is formed when _____
 - a. This helps to _____
 4. Chondroblasts begin to _____
 5. Osteoblasts produce _____ that _____
 - b. External Callus
 1. Forms a _____
 2. Osteoblasts produce _____ & chondroblasts produce _____
 - a. Therefore the external callus is a _____ collar
 3. The external callus _____ the _____ of the broken bone

C. Callus Ossification

1. The cartilage in the external callus is replaced by _____ through _____
 - a. This results in a _____ external callus
2. When is the internal callus ossified? _____

D. Remodeling of Bone

1. Repair is not complete until _____ and _____

IX. Calcium Homeostasis

- A. Blood calcium levels are important for normal function of _____ &

- B. When blood calcium levels are too low _____
- C. When blood calcium levels are too high _____
- D. Parathyroid hormone secretion increases when _____
- E. Functionally parathyroid hormone:
1. Increases the numbers of _____
 2. Causes osteoblasts to _____
 3. Increases calcium uptake by _____
 4. Increases calcium reabsorption _____
- F. Calcitonin is secreted by the _____
- G. Calcitonin is secreted in response to _____
- H. Functionally calcitonin _____

X. Effects of Aging on the Skeletal System

- A. The most significant changes affect the _____ & _____ of matrix
- B. What does decreased collagen production do to bone matrix? _____

- C. Osteoblasts become slower than osteoclasts resulting in _____
- D. Cancellous bone is lost _____ as the trabeculae _____ & _____
- E. What happens when trabeculae become disconnected from each other?

- F. Most loss of compact bone occurs _____
- G. Incomplete bone remodeling causes _____
- H. Loss of trabeculae greatly increases the chance of _____
- I. Loss of bone can cause:
1. _____
 2. Loss of _____
 3. _____ &
 4. _____