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: _____

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III. 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: _____

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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? _____

IV. 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

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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 _____

V. Bone Development

A. Intramembranous Ossification

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

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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 _____

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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 _____ _____ _____

    b. Zone of proliferation _____ _____

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_____

c. Zone of hypertrophy _____

_____

_____

d. 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 _____

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E. Factors Affecting Bone Growth / Nutrition

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? _____

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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 _____

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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. _____

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