

Bone in 1 file: 1st Essay Q&A

1. What's meant by bones?

Bones is type of connective tissue characterized by being hard due to its classified matrix.

2. What are the functions of bones?

- Support & maintain body stature
- Protection of internal vital organs e.g. brain inside the skull
- Give attachments to different body muscles
- Act as a reservoir for calcium, phosphorus and other minerals.

3. Enumerate the types of bones?

- ✓ Compact bones: have regular collagen bundles and hard
- ✓ Cancellous bones: hard irregular collagen bundles and soft

4. Demonstrate the components of bones?

5. What's the function of:

- ✓ Osteocalcin

Binding between Ca + the matrix in bones

- ✓ Osteonectin

Binding between cells + collagen fibers in the matrix

✓ **Sialoprotein**

Adhesion of bone cells + matrix

6. Demonstrate the arrangement of bone that determine the type of bones?

- ✓ Compact bones: have regular collagen bundles
- ✓ Cancellous bones: have irregular collagen bundles

7. What's the most abundant type of fibres in bones? And give account on it?

- ✓ Collagen fibers type 1
- ✓ In H&E section → staining bone matrix by eosinophilic staining
- ✓ Their arrangement in the matrix establishes the initial skeleton of the bone units upon which Ca^{2+} salts are deposited and bone cells are organized.
- ✓ Responsible for tensile property of the bones

8. How collagen fibers removed from bones? Why?

It's removed from bones by denaturation (e.g.: heating) because this cause break down of proteins so cause removal of collagen from bones.

9. How can we remove Ca^{2+} from bones? By strong acid

10. What are the most important components of bones? Why?

The inorganic substances because it responsible for hardness of the bone.

11. Give an account on inorganic substances as one of the components of bones?

- ✓ About 45% of bone's weight
- ✓ Mainly in the form of:
 - Calcium phosphate
 - Calcium carbonate
- ✓ Few ions are found e.g. Na, Mg.
- ✓ It responsible for hardness of the bone

12. Give some examples for clinical abnormalities of the inorganic substances?

- ✓ Osteomalicia
- ✓ Rickets

And both are suffering from marked deficiency of calcium contents in their bones.

13. Enumerate the different types bone cells?

- ✓ Osteoprogenitor
- ✓ Osteoblasts
- ✓ Osteocytes
- ✓ Osteoclasts

14. Give an account on:

- ✓ Osteoprogenitor
- ✓ Osteoblasts
- ✓ Osteocytes
- ✓ Osteoclasts

15. Compare between the 4 types of bones.

16. What's the origin of:

- Osteoprogenitor
- Osteoblasts
- Osteocytes
- Osteoclasts

17. What's the size of:

- Osteoprogenitor
- Osteoblasts
- Osteocytes
- Osteoclasts

18. What's the shape of:

- ✚ Osteoprogenitor
- ✚ Osteoblasts
- ✚ Osteocytes
- ✚ Osteoclasts

19. Demonstrate the L.M of the cytoplasm of:

- Osteoprogenitor
- Osteoblasts
- Osteocytes
- Osteoclasts

20. Demonstrate the L. M of the nucleus of:

- Osteoprogenitor

- Osteoblasts
- Osteocytes
- Osteoclasts

21. Demonstrate the E.M picture of:

- Osteoprogenitor
- Osteoblasts
- Osteocytes
- Osteoclasts

22. What's the function of:

- ✚ Osteoprogenitor
- ✚ Osteoblasts
- ✚ Osteocytes
- ✚ Osteoclasts

<http://www.alexmed.edu.eg/me/mod/resource/view.php?id=2518>

23. What's meant by polarity of:

- Osteoblasts

That's the cells is directed towards the direction of bone formation as this facilitate producing their products into bone forming matrix

- Osteoclasts
 - During bone Resorption: face resorbing areas by their ruffled border
 - This makes them secret more hydrolytic enzymes
 - The displacement of nuclei is toward the smooth surface
 - The orientation of the mitochondria under ruffled border of the cell

24. Demonstrate the surfaces of Osteoclasts?

It has 2 surfaces: Smooth surface - Irregular surface

25. Which type of bones can be called with:

- Dividing cells: Osteoprogenitor
- Mother of the bones: Osteoprogenitor
- Bone forming cells: Osteoblasts
- Protein synthesizing cells: Osteoblasts
- Units of the bones: Osteocytes

- *Maintain the bone structure: Osteocytes*
- *Have processes:*
 - Osteocytes → long process*
 - Osteoblasts (active) → short process*
- *Bone eating cells: Osteoblasts*

26. Give an account on bone Resorption?

- *It's a process by which Osteoblasts remove older osseous tissues*
- *Osteoclasts attach their selves to bones by surface protrusions and then secrete hydrolytic enzymes*
- *Break down organic substances and dissolve the Ca salts from the bone matrix*

27. Enumerate the types of bones?

<i>Primary / Woven bones</i>	<i>Secondary / lamellar bones</i>
<i>an immature weak bone</i>	<i>This is a mature, strong bone</i>
<i>occurring during:</i> <ul style="list-style-type: none"> <i>the prenatal development of bone</i> <i>bone repair</i> 	<i>replaces the primary bone along the process of bone development</i>
<i>Characteristics:</i> <ul style="list-style-type: none"> <i>Low mineral content in the matrix.</i> <i>Irregular collagen bundles.</i> <i>Abundant, irregularly arranged Osteocytes</i> 	<ul style="list-style-type: none"> <i>High calcium content and so is stronger.</i> <i>Regular arrangement of collagen fibers into parallel lamellae.</i> <i>Regular arrangement of Osteocytes between the bone lamellae</i>

28. When do woven bones occur?

Occur during:

- *Bone repair*
- *The prenatal development of bone*

29. Classify secondary bones.

Cancellous	Compact
<p>Found in:</p> <ul style="list-style-type: none"> Flat bones (between the inner and outer tables in these bones) The epiphysis of long bones 	<ul style="list-style-type: none"> The metaphysis and diaphysis of long bones The outer and inner tables of flat bones

30. Give an account on Compact bone?

It's the type of bone, which has well-organized bone units leaving no spaces in between

31. Demonstrate the methods of studying compact bones?

Unstained ground	Stained declassified
<ul style="list-style-type: none"> Bones is grinded by a special bone-grinding machine The resulting bone is mounted on a glass slide covered with Canada balsam and a glass cover then examined directly by the L.M. 	<ul style="list-style-type: none"> Removal of its calcium salts using a strong acid solution e.g. nitric acid or a chelating agent e.g. EDTA. Then, the boney tissue is stained by routine H&E stain

32. How is Ca^{2+} removed from bones? Give examples.

Using:

- strong acid solution e.g. nitric acid
- A chelating agent e.g. EDTA.

33. Demonstrate the histological features around the bones?

- The compact bone has a single centrally located bone marrow cavity. The osseous tissue around this cavity is made up of the following structural components

35. What's Endosteum composed of?

It is formed of 1-2 layers of osteogenic cells lying one next to the other without intervening connective tissue fibers

36. What are the functions of:

- Outer fibrous layer
 - I. It generally supports the bone
 - II. gives attachment to the tendons of muscles at Sharpey's fibers
- Inner cellular layer
 - Continuous supply of new osteoblasts for repair and bone growth
 - Nutrition of bone.
- Endosteum: It acts as a reserve of Osteoblasts
- Sharpey's fibers : fix the Periosteum to inside the substance of bone

37. Give an account on Sharpey's fibers.

- At these sites the collagen fibers are more thickened
- penetrate deep into the bone substance
- They arise from the deep surface of the Periosteum and pass with an angle through the external circumferential lamellae and interstitial lamellae
- fix the Periosteum to inside the substance of bone

38. What's the histological unit of bones? Give an account on it.

✚ It's Bone lamella

✚ It is a cylindrical structure formed by the collagen fibers and the ossified matrix

✚ it extends parallel to the long axis of the bone

✚ When inspected from a top view, the lamella has a circular outline

✚ The bone lamella contains lacunae; occupied by osteocytes.

✚ The processes of the osteocytes communicate together through bony canaliculi to maintain nutrition

✚ The organization of the bone lamellae differs according to the type of bone

39. What does the top view of bone lamella show?

When inspected from a top view, the lamella has a circular outline

40. How do the processes of Osteocytes communicate together? Why?

The processes of the osteocytes communicate together through bony canaliculi to maintain nutrition

41. How is nutrition of lamella maintained?

The processes of the osteocytes communicate together through bony canaliculi to maintain nutrition

42. Enumerate the different organization of bone lamella.

The Circumferential lamellae	The Haversian system	The Intersitial lamella
These are 2-3 parallel bone lamellae that encircle the whole circumference of the bone shaft	It is formed of a cylinder of 4-20 bone lamellae of different diameters	Triangular or irregular shaped groups of parallel bones lamella Filling spaces between haversian system
Composed of: <ul style="list-style-type: none">• <u>The inner circumferential lamellae</u>:which surround the central medullary cavity just above the endosteum.• <u>The outer circumferential lamellae</u>:which lie just under the periosteum.	Haversian canal <ul style="list-style-type: none">• The Haversian canal runs parallel to the long axis of the bone• It is lined by Osteoblasts• It contains loose connective tissue rich in blood vessels and nerves	

43. What's the difference between inner & outer Circumferential lamella?

⇒ The inner circumferential lamellae: above the Endosteum

⇒ The outer circumferential lamellae: under the periosteum.

44. Give an account on:

- Haversian canal

⇒ The Haversian canal runs parallel to the long axis of the bone

⇒ It is lined by Osteoblasts

⇒ It contains loose connective tissue rich in blood vessels and nerves

- Volkmann's canal

⇒ By which haversian canals bifurcate at different levels to communicate with the marrow cavity, with the periosteum and with each other through transverse or oblique canals (volkmann's)

45. What are the functions of:

- Haversian canal

Represent the vascular channels that transport nutritive substances and distribute them throughout the compact bone

- Volkmann's canal

⇒ bony canals carrying blood vessels

⇒ They connect the blood vessels of Haversian canals with each other and with the blood vessels of the Periosteum and the Endosteum

46. What's the difference between Haversian canal & Volkmann's canals?

Red bone marrow is replaced by yellow adipose tissue (in old age and adult hoods)

52. Compare between the Periosteum & Endosteum of cancellous bones?

Periosteum	Endosteum
Cover the outer surface of cancellous bones	Line bone marrow cavities
The same components as compact bones	Formed of layer of osteobalsts

53. What's the result of intramembranous ossification of bone?

It results in the formation of flat bones (membrane bones) and thickening of long bones

54. During intramembranous ossification, the blood supply increases. Give reasons.

To provide enough mineral salts and nutrition needed for bone formation.

55. Mention the steps that take place during intramembranous ossification of bone during prenatal life.

- Increase C.T. vascularity in the area of the developing bone
- Condensation of undifferentiated mesenchymal cells.
- Mesenchymal cells proliferate and differentiate into osteoprogenitor cells.
- Osteoproginator cells differentiation to osteoblasts.
- Osteoblasts lay down bone matrix.
- Once become entrapped within lacunae, osteblasts transformed to osteocytes.
- This process proceeds resulting in the formation of irregular bone trabeculae.
- Spaces between trabeculae will form bone marrow cavities.
- Mesenchymal cells within the cavities give rise to bone marrow cells.
- Osteblasts line bone marrow cavities to form endosteum.
- The C.T covering the area will form the periosteum.

56. How is compact bone of inner and outer tables of flat bone formed?

At the periphery, bone trabeculae become thickened and transformed into well-organized lamellae with regularly arranged osteocytes to form the compact bone of outer & inner tables of flat bones.

57. Why does endochondral ossification occur?

Bone formation occurs for:

1. Growth of bone:

- Increase in length
- Increase in width
- Bone remodeling

2. Repair of bone fractures

58. Enumerate the steps of endochondral ossification.

- a) Zone of resting cartilage.
- b) Zone of proliferating chondrocytes.
- c) Zone of regular arrangement.
- d) Zone of maturation and hypertrophy.
- e) Zone of calcified cartilage.
- f) Zone of degenerating cartilage.
- g) Zone of ossification.
- h) Zone of cancellous bone.
- i) Zone of reorganization.

59. During endochondral ossification, which type of growth is common in the zone of proliferating chondrocytes?

Interstitial growth of cartilage cells

60. Mention one characteristic of the zone of hypertrophy and maturation.

The chondrocytes accumulate large amounts of glycogen and lipids in their cytoplasm.

61. How is cartilage calcified? What does this lead to?

The hypertrophied chondrocytes start to release alkaline phosphatase enzyme causing calcification of the cartilage matrix.

This leads to interfering with diffusion of sufficient nutrients to the hypertrophied chondrocytes. This results in their degeneration and death.

62. Explain the characteristics of zone of ossification.

- The chondroblasts of the perichondrium will be replaced by osteoblasts, thus the perichondrium becomes a periosteum.
- Vascular **mesenchymal buds** (periosteal buds) arise from the cellular layer of the periosteum to invade the ossifying zone.
- The mesenchymal bud is made up of loose connective tissue containing blood vessels, mesenchymal cells and macrophages.
- The macrophages are differentiated into active osteoclasts which phagocytose the calcified cartilage matrix and the remnants of dead chondrocytes leaving wide empty lacunae (cavities)
- The mesenchymal cells differentiate to osteoprogenitor cells which differentiate to osteoblasts,
- The osteoblasts come to lie side by side lining the formed cavities and start to lay-down bony matrix and promote its calcification.

63. How does bone increase in width?

This is achieved by two simultaneous mechanisms:

1. Subperiosteal bone formation (appositional intramembranous growth):
Adding new layers from outside (periosteum)
2. Bone resorption by osteoclasts at the endosteum (from inside) to enlarge the marrow cavity.

64. What's meant by bone remodeling?

It means continuous renewal of bone tissue (a *balanced* continuous state of bone resorption and simultaneous replacement by new bone formation).

65. What's the importance of bone remodeling?

Bone remodeling is important for:

- 1- Replacement of immature bone by mature bone.
- 2- Maintenance of bone structure and shape throughout life.

66. What is the function of bones?

- A) Mechanical, for locomotion.
- B) Protective, for organs.
- C) Metabolic as a reservoir of minerals, especially calcium and phosphorus.

67. What are the components of bones?

- Bone is composed primarily of an extracellular mineralized matrix.
- The organic matrix is mineralized by the deposition of calcium and phosphate in small, hydroxyapatite crystals with lesser amounts of carbonate, magnesium, sodium, potassium and various ions.

68. What are the factors influence the bone growth and turnover?

Bone growth and turnover are influenced by the metabolism of calcium, phosphate and magnesium and a number of hormones.

The primary ones being parathyroid hormone (PTH) ,and 1-25 dihydroxy vitamin D and calcitonin.

69. What is the percentage of calcium, phosphorus and magnesium in relation to the body?

Bone contains nearly all of the calcium (99%), most of phosphate (85%), and much of the magnesium (55%) of the body.

70. What is the daily requirement of calcium in different ages?

- Infants 360-540 mg/day
- Adults 800 mg/day
- Children (1-18 years) 0.8-1.2 g/day
- During pregnancy and lactation 1.2 g/day.

71. What are the sources of calcium?

Milk and cheese are the major sources, egg yolk, vegetables and cereals are good sources for calcium.

72. How the calcium absorbed in the intestine and the kidney?

- Absorption of calcium occurs in the upper part of small intestine.
- 1-25-dihydroxycholecalciferol which is formed by the hydroxylation of
- 25-hydroxycholecalciferol (formed in the liver) in the kidney increases active calcium absorption in the intestine by induction of formation of mRNA for the synthesis of calcium-binding proteins

- So, the active form of vitamin D₃ acts as a hormone secreted in the kidney and its target organ in the intestine and there is a feedback regulation between serum calcium level and 1-25-dihydroxycholecalciferol, i.e. when there is increased serum calcium, the level of the hormone is decreased and calcium absorption is diminished.

73. What are the factors which increase calcium absorption?

- 1) Vitamin D
- 2) Proteins as calcium is more soluble in amino acids than in water;
- 3) Acidity, the low pH helps calcium absorption;
- 4) Lactose of milk helps calcium absorption as it is changed in the intestine into lactic acid which lowers the pH.

74. What are the factors which inhibit calcium absorption?

- 1) Excess phosphorus inhibits calcium absorption as it forms insoluble calcium phosphate salts. A ratio of Ca: P between 1:2 to 2: 1 is the most ideal for absorption of both calcium and phosphorus.
- 2) Excess oxalates in the diet precipitate calcium.
- 3) Excess phytates form calcium salt (phytin).
- 4) Excess fats as in cases of impaired fat absorption, inhibit calcium absorption as calcium salts of fatty acids (soap) which are insoluble are formed

75. How is calcium distributed inside the body?

- The total body content of calcium is about 1-1.2 Kg. 99% of total body calcium is present in the skeleton as crystalline calcium phosphate in the hydroxyapatite ($\text{Ca}_{10}[\text{PO}_4]_6[\text{OH}]_2$).
- 1% of total body calcium is present in body fluids, where it is, in part, ionized and this ionized fraction is the important part for the physiologic activity of calcium.

76. What is calcium plasma level?

Varies between 9-11 mg/dL. The plasma calcium exists in three fractions:

- 1) Ionized (diffusible) calcium (53%);

- 2) Protein-bound (non-diffusible) calcium
- 3) Complexed citrate (diffusible).

77. How is parathormone affect calcium metabolism?

Leads to:

- (a) Increased serum calcium and lowered serum phosphorus
- (b) Increased urinary excretion of phosphorus and decreased urinary excretion of calcium
- (c) Mobilization of calcium from the bones
- (d) Increased serum alkaline phosphatase
- (e) Activation of vitamin D to 1-25-dihydroxycholecalciferol.

78. How calcitonin can affect calcium metabolism?

- (a) Effect on bones opposite to parathormone
- (b) Increased calcium excretion by the kidney
- (c) Inhibition of 1, 25-dihydroxycholecalciferol synthesis.

79. What is the important of calcium/phosphorus?

It is important for normal ossification.

80. What is the product of Ca x P in normal adults, in infants and in rickets?

The product of Ca x P in normal adults is about 50, and in infants it may reach up to 70. In rickets, this product may be below 30.

81. What is the importance of calcium?

- (1) Calcification of bones and teeth
- (2) Blood clotting as activator of thrombokinase
- (3) It is important for normal contractility and excitability of heart, muscles and nerves
- (4) It decreases cell membrane permeability and so it is used in treatment of allergic conditions

82. How can a disease in the parathyroid gland affect calcium level?

a) In hyperparathyroidism:

There is hypercalcemia, hypophosphatemia, hyperphosphaturia and mobilization of calcium from the bones.

b) In hypoparathyroidism:

The serum calcium level is below 7 mg/dL, hyperphosphatemia and hypophosphaturia. Hypocalcemia leads to tetany.

83. Write short notes on osteoporosis?

Results with low calcium high protein intake and it is common in females after menopause

84. Write short notes on rickets?

- Faulty calcification of bones in infants due to low vitamin D content of the body
- There is low serum and urinary calcium and phosphorus level.
- The Ca x P product is below 30.

85. What is the daily requirement of phosphorus?

Since calcium is usually related to phosphorus in foods, the same daily allowances for calcium are required for phosphorus in adults.

In infants, a ratio of 1.5 to 1 of calcium to phosphorus in the diet is required.

86. What are the sources of phosphorus?

Milk and milk products, proteins as sweat and fish products

87. What is the distribution of phosphorus inside the body?

The normal human body contains 0.7 to 0.9 Kg phosphorus, 80% is present with calcium in bones and teeth, 10% is present in combination with proteins, lipids and carbohydrates in blood and muscles, and 10% in various chemical compounds as coenzymes, DNA and RNA and creatine phosphate

88. What is the plasma level of phosphorus?

Adults 3-4.5 mg/dL, children up to 7 mg/dL

89. How is phosphorus metabolized inside the body?

- 1) Parathyroid hormone lowers serum phosphorus and increases its urinary excretion;
- 2) Vitamin D helps intestinal absorption of phosphorus;

- 3) Increased carbohydrate metabolism (after meals) is accompanied by temporary decrease in serum phosphorus
- 4) In diabetes mellitus, there is a lower concentration of organic phosphorus and higher serum inorganic phosphorus;
- 5) Growth hormone increases serum phosphorus level.

90. What is the function of phosphorus?

1. Enters the formation of bones and teeth.
2. Formation of high energy compounds as ATP and creatine phosphate.
3. Enters the formation of coenzymes as NAD, NADP and FAD.
4. Enters in the metabolism of carbohydrates as esters of hexoses, pentoses and trioses.
5. It is important in the metabolism of lipids for the biosynthesis of phospholipids present in cell membranes.
6. It enters in the structure of nucleotides and nucleic acids.
7. It is important for blood buffers as salts of NaH_2PO_4 and Na_2HPO_4 .

91. Mention the abnormal levels of phosphorus?

- A) Hypophosphatemia: With hypophosphaturia as in rickets
- B) Hyperphosphataemia: As in renal failure, hypoparathyroidism and acromegaly.

2nd Multiple choice questions

1. What is compact bone?

- a. Dense bone
- b. Woven bone
- c. Immature bone
- d. Cancellous bone
- e. Spongy bone

Answer: a

- Compact bone is also called dense bone. Compact bone has the Haversian system.
- Immature bone is woven bone. It is non-lamellar bone or bundle bone.

- Spongy bone is also referred to as cancellous bone.
- The mineralized tissue is seen as spicules. Marrow spaces are also present.

2. *What cell is involved in bone resorption?*

- a. Osteoclast
- b. Osteon
- c. Osteocyte
- d. Osteoblast
- e. Osteoid

Answer: a

- An osteoclast is a multinucleated cell involved in the degradation of bone. It is a bone resorbing cell.
- An osteon is the cylindrical structure with bone. An osteon is also called a Haversian system.
- The mature bone cell is called an osteocyte. It sits in a space, called a lacuna.
- An osteoblast is an immature bone cell. The osteoblast is the bone forming cell.
- Osteoid is unmineralized bone matrix.

3. *What type of basic tissue type is bone?*

- a. Epithelium
- b. Connective tissue
- c. Muscle
- d. Nervous
- e. Bone

Answer: b

Of the four basic tissue types (epithelium, connective tissue, muscle and nervous tissue), connective tissue is the most diverse. Bone is a type of connective tissue.

Histology hint from Sarah Bellham: Keep in mind that the word "bone" can refer to either a type of tissue or to the organ. As a tissue, bone tissue is a type of connective tissue. When referring to a bone (the organ), there will be several types of tissue present.

4. *What is woven bone?*

- a. Cancellous bone
- b. Compact bone
- c. Dense bone
- d. Immature bone
- e. Spongy bone

Answer: d

Compact bone is also called dense bone. Compact bone has the Haversian system.

Immature bone is woven bone. It is nonlamellar bone or bundle bone.

Spongy bone is also referred to as cancellous bone. The mineralized tissue is seen as spicules. Marrow spaces are also present.

5. *What are the spicules on spongy bone called?*

- a. Canaliculi
- b. Sharpey's fibers
- c. Trabeculae
- d. Tome's process
- e. Lacuna

Answer: c

Canaliculi are the little tunnels within bone.

Sharpey's fibers are collagen fibers that extend into a bone at an angle.

Trabeculae are the spicules seen with spongy bone.

Tome's process is seen in teeth, this process is responsible for enamel production.

An osteocyte rests in a space called a lacuna.

6. Which cell type is responsible for bone breakdown?

- a. Chondrocyte
- b. Chondroblast
- c. Osteocyte
- d. Osteoclast
- e. Bone lining cell

Answer: d

The mature cell in cartilage is a chondrocyte. It rests in a lacunae surrounded by matrix. A chondroblast is an immature cartilage cell which produces the cartilaginous matrix. An osteocyte is a mature bone cell. An osteoclast is a bone cell which is involved in resorption of bone. A bone lining cell is a resting osteoblast.

7. What is bone formation called when the bone is formed directly, without using a cartilage template?

- a. Intraosseous
- b. En bloc
- c. Intramembranous
- d. Endochondral
- e. Endosteum

Answer: c

Intramembranous bone formation is the process of bone formation where the bone is formed without a cartilage template. Endochondral bone formation is the process of bone formation where the bone is formed using a cartilage template.

8. What forms the epiphyseal growth plate?

- a. Elastic cartilage
- b. Fibrocartilage
- c. Hyaline cartilage
- d. Compact bone
- e. Spongy bone

Answer: c

Hyaline cartilage forms the epiphyseal growth plate.

9. Which type of bone has spicules?

- a. Immature bone
- b. Dense bone
- c. Compact bone
- d. Cancellous bone
- e. Woven bone

Answer: d

Compact bone is also called dense bone. Compact bone has the Haversian system.

Immature bone is woven bone. It is nonlamellar bone or bundle bone.

Spongy bone is also referred to as cancellous bone. The mineralized tissue is seen as spicules. Marrow spaces are also present.

10. What sits in a lacuna?

- a. Osteoclast
- b. Osteon
- c. Osteocyte
- d. Osteoblast
- e. Osteoid

Answer: c

An osteoclast is a multinucleated cell involved in the degradation of bone. It is a bone resorbing cell.

An osteon is the cylindrical structure with bone. An osteon is also called a Haversian system.

The mature bone cell is called an osteocyte. It sits in a space, called a lacuna.

An osteoblast is an immature bone cell. The osteoblast is the bone forming cell.

Osteoid is unmineralized bone matrix.

11. What is dense bone?

- a. Immature bone
- b. Cancellous bone
- c. Compact bone
- d. Woven bone
- e. Spongy bone

Answer: c

Compact bone is also called dense bone. Compact bone has the Haversian system.

Immature bone is woven bone. It is nonlamellar bone or bundle bone.

Spongy bone is also referred to as cancellous bone. The mineralized tissue is seen as spicules. Marrow spaces are also present.

12. Which cell is a resting osteoblast?

- a. Chondrocyte
- b. Chondroblast
- c. Osteocyte
- d. Osteoclast
- e. Bone lining cell

Answer: e

The mature cell in cartilage is a chondrocyte. It rests in a lacunae surrounded by matrix. A chondroblast is an immature cartilage cell which produces the cartilaginous matrix. An osteocyte is a mature bone cell. An osteoclast is a bone cell which is involved in resorption of bone. A bone lining cell is a resting osteoblast.

13. What are the mineral crystals in bone called?

- a. Hydroxyapatite
- b. Calcite
- c. Tourmaline
- d. Rubellite
- e. Indicolite

Answer: a

Calcium is in a mineral structure in bone and tooth enamel called hydroxyapatite. The chemical formula is $[Ca_{10}(PO_4)_6(OH)_2]$

Calcite crystals are calcium carbonate. The main component of limestone is calcite and seashells are made of calcite. However, calcite crystals are not found in man.

Tourmaline is a crystal found in nature. Pink-red tourmaline is called rubellite. Blue tourmaline is known as indicolite. Tourmaline crystals are not found in man, although sometimes they are found on the necks and fingers of women in the form of jewellery.

14. What is the cylindrical structure in compact bone?

- a. Osteoclast
- b. Osteon
- c. Osteocyte
- d. Osteoblast
- e. Osteoid

Answer: b

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The mature bone cell is called an osteocyte. It sits in a space, called a lacuna.

An osteoblast is an immature bone cell. The osteoblast is the bone forming cell.

Osteoid is unmineralized bone matrix.

15. What are Sharpey's fibers?

- a. Elastic fibers
- b. Collagen fibers
- c. Reticular fibers

- d. Trabeculae
- e. Dense regular connective tissue

Answer: b

Sharpey's fibers are collagen fibers that extend into a bone at an angle.

16. What is the space that an osteocyte rests in?

- a. Canaliculi
- b. Sharpey's fibers
- c. Trabeculae
- d. Tome's process
- e. Lacuna

Answer: e

Canaliculi are the little tunnels within bone.

Sharpey's fibers are collagen fibers that extend into a bone at an angle.

Trabeculae are the spicules seen with spongy bone.

Tome's process is seen in teeth, this process is responsible for enamel production.

An osteocyte rests in a space called a lacuna.

17. What is bone formation called when the bone is formed from a cartilage template?

- a. Intraosseous
- b. En bloc
- c. Intramembranous
- d. Endochondral
- e. Endosteum

Answer: d

Intramembranous bone formation is the process of bone formation where the bone is formed without a cartilage template. Endochondral bone formation is the process of bone formation where the bone is formed using a cartilage template.

18. What is the primary component of red marrow?

- a. Hematopoietic tissue
- b. Fat
- c. Cartilage
- d. Fibrous tissue
- e. Bone

Answer: a

Red marrow contains active hematopoietic tissue. Yellow marrow is primarily fat.

19. What cell is an immature bone cell?

- a. Osteoclast
- b. Osteon
- c. Osteocyte
- d. Osteoblast
- e. Osteoid

Answer: d

An osteoclast is a multinucleated cell involved in the degradation of bone. It is a bone resorbing cell.

An osteon is the cylindrical structure with bone. An osteon is also called a Haversian system.

The mature bone cell is called an osteocyte. It sits in a space, called a lacuna.

An osteoblast is an immature bone cell. The osteoblast is the bone forming cell.

Osteoid is unmineralized bone matrix.

20. What is bundle bone?

- a. Cancellous bone
- b. Compact bone
- c. Dense bone

- d. Spongy bone
- e. Immature bone

Answer: e

Compact bone is also called dense bone. Compact bone has the Haversian system.

Immature bone is woven bone. It is nonlamellar bone or bundle bone.

Spongy bone is also referred to as cancellous bone. The mineralized tissue is seen as spicules. Marrow spaces are also present.

20. What is cancellous bone?

- a. Dense bone
- b. Woven bone
- c. Immature bone
- d. Compact bone
- e. Spongy bone

Answer: e

Compact bone is also called dense bone. Compact bone has the Haversian system.

Immature bone is woven bone. It is nonlamellar bone or bundle bone.

Spongy bone is also referred to as cancellous bone. The mineralized tissue is seen as spicules. Marrow spaces are also present.

21. What cell is involved in laying down new bone?

- a. Osteoclast
- b. Osteon
- c. Osteocyte
- d. Osteoblast
- e. Osteoid

Answer: d

An osteoclast is a multinucleated cell involved in the degradation of bone. It is a bone resorbing cell.

An osteon is the cylindrical structure with bone. An osteon is also called a Haversian system.

The mature bone cell is called an osteocyte. It sits in a space, called a lacuna.

An osteoblast is an immature bone cell. The osteoblast is the bone forming cell.

Osteoid is unmineralized bone matrix.

22. What is in the bone matrix?

- a. Elastic fibers
- b. Collagen fibers
- c. Reticular fibers
- d. Dense irregular connective tissue
- e. Dense regular connective tissue

Answer: b

The matrix of bone is mineralized. Within the matrix are collagen fibers and proteoglycans.

Elastic fibers and reticular fibers are types of fibers seen in connective tissue. However, collagen fibers are the fibers found in bone.

Although bone is classified as a connective tissue, it is not classified nor is it composed of dense irregular connective tissue. Dense irregular tissue is seen in the dermis.

Bone is not classified nor is it composed of dense regular connective tissue. Dense regular connective tissue is seen in tendons and ligaments.

23. What are the small tunnels seen in bone?

- a. Canaliculi
- b. Sharpey's fibers
- c. Trabeculae
- d. Tome's process
- e. Lacuna

Answer: a

Canaliculi are the little tunnels within bone.

Sharpey's fibers are collagen fibers that extend into a bone at an angle.

Trabeculae are the spicules seen with spongy bone.

Tome's process is seen in teeth, this process is responsible for enamel production.

An osteocyte rests in a space called a lacuna.

24. What is the hollow area underneath an osteoclast called?

- a. Space of Disse
- b. Space of Mall
- c. Vacuole
- d. Lacuna
- e. Howship's lacuna

Answer: e

The space of Disse is in the liver. The space of Disse is also called the perisinusoidal space. It is the space between the liver sinusoids and the hepatocytes.

The space of Mall is also in the liver. The space of Mall is located at the portal canal and is the region between the connective tissue and the liver parenchymal cells. It is the site where lymph is formed within the liver.

A vacuole is a small clear space within an individual cell.

A lacuna is a small space or depression. The space that the chondrocyte rests in is a lacuna.

Howship's lacuna is seen in bone. Howship's lacuna is a space seen underneath an osteoclast.

25. What is the covering of a bone?

- a. Perimysium
- b. Periosteum
- c. Perichondrium
- d. Perineurium
- e. Endosteum

Answer: b

The perimysium is the connective tissue sheath which surrounds muscle fascicles.

The periosteum is the connective tissue covering of a bone.

The perichondrium is the connective tissue which surrounds cartilage.

The perineurium is the covering of nerve fascicles.

The endosteum is the lining of the inner bone (the side which abuts the medullary cavity).

26. What forms the articular surface on bones?

- a. Spongy bone
- b. Compact bone
- c. Hyaline cartilage
- d. Elastic cartilage
- e. Fibrocartilage

Answer: c

Hyaline cartilage forms the articular surface on bones.

27. What is the primary component of yellow marrow?

- a. Hematopoietic tissue
- b. Fat
- c. Cartilage
- d. Fibrous tissue
- e. Bone

Answer: b

Red marrow contains active hematopoietic tissue. Yellow marrow is primarily fat.

28. What is another term for the Haversian system?

- a. Osteoclast
- b. Osteon
- c. Osteocyte

d. Osteoblast

e. Osteoid

Answer: b

An osteoclast is a multinucleated cell involved in the degradation of bone. It is a bone resorbing cell.

An osteon is the cylindrical structure with bone. An osteon is also called a Haversian system.

The mature bone cell is called an osteocyte. It sits in a space, called a lacuna.

An osteoblast is an immature bone cell. The osteoblast is the bone forming cell.

Osteoid is unmineralized bone matrix.

29. What is nonlamellar bone?

a. Woven bone

b. Dense bone

c. Cancellous bone

d. Compact bone

e. Spongy bone

Answer: a

Compact bone is also called dense bone. Compact bone has the Haversian system.

30. What is the mature bone cell called?

a. Osteoclast

b. Osteon

c. Osteocyte

d. Osteoblast

e. Osteoid

Answer: c

An osteoclast is a multinucleated cell involved in the degradation of bone. It is a bone resorbing cell.

An osteon is the cylindrical structure with bone. An osteon is also called a Haversian system.

The mature bone cell is called an osteocyte. It sits in a space, called a lacuna. An osteoblast is an immature bone cell. The osteoblast is the bone forming cell. Osteoid is unmineralized bone matrix.

31. What is immature bone?

- a. Dense bone
- b. Woven bone
- c. Cancellous bone
- d. Compact bone
- e. Spongy bone

Answer: b

Compact bone is also called dense bone. Compact bone has the Haversian system.

Immature bone is woven bone. It is nonlamellar bone or bundle bone.

Spongy bone is also referred to as cancellous bone. The mineralized tissue is seen as spicules. Marrow spaces are also present.

32. What is unmineralized bone matrix?

- a. Osteoclast
- b. Osteon
- c. Osteocyte
- d. Osteoblast
- e. Osteoid

Answer: e

An osteoclast is a multinucleated cell involved in the degradation of bone. It is a bone resorbing cell.

An osteon is the cylindrical structure with bone. An osteon is also called a Haversian system.

The mature bone cell is called an osteocyte. It sits in a space, called a lacuna.

An osteoblast is an immature bone cell. The osteoblast is the bone forming cell.

Osteoid is unmineralized bone matrix.

33. What are the collagen fibers that extend into bone at an angle called?

- a. Canaliculi
- b. Sharpey's fibers
- c. Trabeculae
- d. Tome's process
- e. Lacuna

Answer: b

Canaliculi are the little tunnels within bone.

Sharpey's fibers are collagen fibers that extend into a bone at an angle.

Trabeculae are the spicules seen with spongy bone.

Tome's process is seen in teeth, this process is responsible for enamel production.

An osteocyte rests in a space called a lacuna.

34. Which cell is the mature bone cell?

- a. Chondrocyte
- b. Chondroblast
- c. Osteocyte
- d. Osteoclast
- e. Bone lining cell

Answer: c

The mature cell in cartilage is a chondrocyte. It rests in a lacunae surrounded by matrix. A chondroblast is an immature cartilage cell which produces the cartilaginous matrix. An osteocyte is a mature bone cell. An osteoclast is a bone cell which is involved in resorption of bone. A bone lining cell is a resting osteoblast.

35. What is the lining of the inner bone on the side which abuts the medullary cavity?

- a. Perimysium

- b. Periosteum
- c. Perichondrium
- d. Perineurium
- e. Endosteum

Answer: e

The perimysium is the connective tissue sheath which surrounds muscle fascicles.

The periosteum is the connective tissue covering of a bone.

The perichondrium is the connective tissue which surrounds cartilage.

The perineurium is the covering of nerve fascicles.

The endosteum is the lining of the inner bone (the side which abuts the medullary cavity).

36. What forms the skeleton of the fetus?

- a. Elastic cartilage
- b. Hyaline cartilage
- c. Fibrocartilage
- d. Spongy bone
- e. Compact bone

Answer: b

Hyaline cartilage forms the skeleton of the fetus. The cartilage forms a template of the bones. Endochondral ossification will occur during the childhood, replacing the hyaline cartilage with bone.

37. Which of the following is a multinucleated cell?

- a. Osteoclast
- b. Osteon
- c. Osteocyte
- d. Osteoblast
- e. Osteoid

Answer: a

An osteoclast is a multinucleated cell involved in the degradation of bone. It is a bone resorbing cell.

An osteon is the cylindrical structure with bone. An osteon is also called a Haversian system.

The mature bone cell is called an osteocyte. It sits in a space, called a lacuna.

An osteoblast is an immature bone cell. The osteoblast is the bone forming cell.

Osteoid is unmineralized bone matrix.

38. What is spongy bone:

- a. Immature bone
- b. Compact bone
- c. Cancellous bone
- d. Dense bone
- e. Woven bone

Answer: c

Compact bone is also called dense bone. Compact bone has the Haversian system.

Immature bone is woven bone. It is nonlamellar bone or bundle bone.

Spongy bone is also referred to as cancellous bone. The mineralized tissue is seen as spicules. Marrow spaces are also present.

39. Normal bone formation and growth are dependent on the adequate intake of _____.

- A) calcium, phosphate, and vitamin D
- B) vitamin D, phosphate, and chloride
- C) sodium, calcium, and vitamin E
- D) potassium, phosphate, and vitamin D

Answer: a

41) Bones are covered and lined by a protective tissue called periosteum. The inner (osteogenic) layer consists primarily of _____.

- A) chondrocytes and osteocytes

- B) cartilage and compact bone
- C) osteoblasts and osteoprogenitors
- D) marrow and osteons

Answer: c

42) Ossification of the ends of long bones _____

- A) is a characteristic of intramembranous bone formation
- B) involves medullary cavity formation
- C) takes twice as long as diaphysis
- D) is produced by secondary ossification centers

Answer: a

43) Spongy bones are made up of a framework called _____.

- A) trabeculae
- B) osteons
- C) lamellar bone
- D) osseous lamellae

Answer: a

44) For intramembranous ossification to take place, which of the following is necessary?

- A) A bone collar forms around the cartilage model.
- B) The cartilage matrix begins to deteriorate.
- C) An ossification center forms in the fibrous connective tissue.
- D) A medullary cavity forms.

Answer: d

45) Which hormone increases osteoclast activity to release more calcium ions into the bloodstream?

- A) estrogen
- B) parathyroid hormone
- C) calcitonin

D) thyroxine

Answer: b

46) _____ are not one of the four cell types that populate bone tissue in adults.

A) Mesenchymal cells

B) Osteoprogenitor cells

C) Osteocytes

D) Osteoblasts

Answer: a

47) The small spaces in bone tissue that are holes in which osteocytes live are called _____.

A) trabeculae

B) Volkmann's canals

C) Haversian canals

D) lacunae

Answer: d

48) The structural unit of compact bone is _____.

A) the osteon

B) osseous matrix

C) lamellar bone

D) spongy bone

Answer: c

49) The periosteum is secured to the underlying bone by dense connective tissue called _____.

A) Volkmann's canals

B) the struts of bone known as spicules

C) a bony matrix with hyaline cartilage

D) Perforating (Sharpey's) fibers

Answer: d

50) Lengthwise, long bone growth during infancy and youth is exclusively through _____.

- A) calcification of the matrix
- B) the secretion of bone matrix into the medullary cavity
- C) differentiation of osteoclasts
- D) interstitial growth of the epiphyseal plates

Answer: d

51) In the epiphyseal plate, cartilage grows _____.

- A) from the edges inward
- B) in a circular fashion
- C) by pulling the diaphysis toward the epiphysis
- D) by pushing the epiphysis away from the diaphysis

Answer: d

52) The structure of bone tissue suits the function. Which of the following bone tissues is adapted to support weight and withstand tension stress?

- A) trabecular bone
- B) compact bone
- C) irregular bone
- D) spongy bone

Answer: b

53) The canal that runs through the core of each osteon (the Haversian canal) is the site of _____.

- A) blood vessels and nerve fibers
- B) osteoclasts and osteoblasts
- C) yellow marrow and spicules
- D) cartilage and interstitial lamellae

Answer: a

54) Osteogenesis is the process of _____.

- A) bone formation
- B) making collagen fibers for calcified cartilage
- C) making a cartilage model of the fetal bone
- D) bone destruction to liberate calcium

Answer: a

55) It is thought that remodeling or bone growth is in response to the forces placed on it. Which of the following hypotheses may explain how mechanical forces communicate with cells responsible for bone remodeling?

- A) Vitamin D enhances the remodeling process.
- B) Increase in the synthesis of growth hormone directs the remodeling process.
- C) Electrical signals direct the remodeling process.
- D) Bone deposition by osteoclasts is responsible for remodeling.

56) The cell responsible for secreting the matrix of bone is the _____.

- A) osteocyte
- B) chondrocyte
- C) osteoclast
- D) osteoblast

57) Factors in preventing (or delaying) osteoporosis include _____.

- A) increasing dietary vitamin C
- B) decreasing exposure to the sun
- C) drinking fluoridated water
- D) decreasing weight-bearing exercise

58) Which of the following glands or organs produces hormones that tend to decrease blood calcium levels?

- A) pineal gland
- B) parathyroid
- C) thyroid
- D) spleen

Answer: c

59) Which of the following is (are) *not* the function(s) of the skeletal system?

- A) support
- B) communication
- C) storage of minerals
- D) production of blood cells (hematopoiesis)

Answer: b

60) The process of bones increasing in width is known as _____.

- A) closing of the epiphyseal plate
- B) appositional growth
- C) concentric growth
- D) long bones reaching adult length and width

Answer: b

61) Select the correct statement concerning the location of blood-forming tissue.

- A) Blood-forming tissue is found in the skull and pelvic bones only.
- B) There is blood-forming marrow in most short bones of an adult.
- C) There is blood-forming marrow in the diaphysis of most long bones of an adult.
- D) The sternum (breastbone) is a good source of blood-forming tissue.

Answer: c

Write 'T' if the statement is true and 'F' if the statement is false.

62) Hematopoiesis refers to the formation of blood cells within the red marrow cavities of certain bones. (T)

63) An osteon contains osteocytes, lamellae, and a central canal, and is found in compact bone only. (F)

64) The periosteum is a tissue that serves only to protect the bone because it is not supplied with nerves or blood vessels. (F)

65) The structural unit of compact bone (osteon) resembles the growth rings of a tree trunk. (T)

66) Sixty-five percent of the mass of bone is a compound called hydroxyapatite. (F)

67) All bones formed by intramembranous ossification are irregular bones. (F)

68) Cartilage has a flexible matrix which can accommodate mitosis of chondrocytes. (T)

69) Compact bone is replaced more often than spongy bone. (T)

70) Short, irregular, and flat bones have large marrow cavities in order to keep the weight of the bones light. (F)

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