MICROSCOPIC ANATOMY
MUSCLE WEAKNESS & WEIGHT LOSS MODULES
OCTOBER 31, 2003

PART I: MULTIPLE CHOICE

DIRECTIONS: Each of the numbered items or incomplete statements is followed by answers or by completions of the statement. Select the ONE lettered answer or completion that is BEST in each case.

18. The medulla of the adrenal gland arises from:
   A. Endoderm of the primitive gut tube
   B. First wave of mesoderm of the body wall
   C. Neural crest cells
   D. Second wave of mesoderm of the body wall

19. The neurohypophysis:
   A. Contains the cell bodies of oxytocin-producing neurons
   B. Has an epithelial appearance due to the presence of many large, closely packed cells that have large amounts of cytoplasm
   C. Includes the pars intermedia
   D. Is characterized by Herring bodies whose secretory granules contain peptide hormones
   E. Is located anterior to the adenohypophysis

20. Free nerve endings respond to:
   A. Painful stimuli associated with tissue damage
   B. Mechanical displacement of skin
   C. Temperature changes
   D. Movement of hair follicles
   E. All of the above

21. Parafollicular cells of the thyroid gland:
   A. Are derived from neural crest cells via the ultimobranchial bodies
   B. Assist in the absorption of colloid from the follicle
   C. Use lysosomal digestion to produce the active form of their hormone
   D. All of the above
22. Which of the following is true of bone matrix:
A. Osteoblasts directly secrete hydroxyapatite into the extracellular matrix
B. Mineralization of extracellular matrix initiates the production of osteoid
C. During the mineralization process, Type II collagen is replaced by hydroxyapatite
D. Matrix vesicles containing alkaline phosphatase control the initial site of mineral deposition

23. In skeletal muscle:
A. Titin is an accessory protein that anchors thin filaments to the Z line
B. During contraction, the length of the A band is not altered, but the length of the I band and the H zone is
C. Myosin molecules lie head to tail in the bare region
D. Thin filaments are anchored to the Z line by C protein and myomesin
E. The length of the sarcomere decreases due to contraction of the actin filaments in the I band

24. The cortex of the fetal adrenal gland produces steroid hormones in conjunction with the:
A. Fetal thyroid
B. Maternal adrenal
C. Maternal hypophysis
D. Placenta

25. Which of the following is derived from oral ectoderm:
A. Hypothalamus
B. Infundibular process
C. Pars distalis
D. Pars nervosa

26. The renin-angiotensin system is important in regulating secretion from the:
A. Adrenal medulla
B. Parafollicular cells of the thyroid
C. Zona fasciculata
D. Zona glomerulosa
E. Zona reticularis
27. Oxyphil cells of the parathyroid are acidophilic due to the presence of:
   A. Cytoplasmic enzymes for the synthesis of PTH
   B. Numerous mitochondria
   C. Plasmalemmal infoldings
   D. Secretory granules stored in the cytoplasm
   E. Numerous lysosomes

28. The circulations of adjacent osteons are interconnected via:
   A. Haversian canals
   B. Gap junctions between osteocyte processes
   C. Cement lines
   D. Canaliculi
   E. Volkmann’s canals

29. Pacinian corpuscles:
   A. Are slowly adapting mechanoreceptors
   B. Are usually located in dermal papillae
   C. Have a multilayered capsule that includes an inner core composed of Schwann cells
   D. Are the most numerous sensory receptor in the skin
   E. Are enlarged nerve endings that are associated with modified epithelial cells in the epidermis

30. Which of the following is true concerning the types of skeletal muscle fibers:
   A. High concentrations of cytochromes contribute to the characteristic ‘red’ color of slow-twitch muscle fibers
   B. Any one skeletal muscle will contain either red fibers or white fibers, but never both
   C. Red fibers are adapted for producing precise, fine movements
   D. Though differing in appearance histochemically, there is no functional difference between red and white muscle fiber types

31. Which statement concerning cartilage tissue is true:
   A. The mechanical properties of a piece of cartilage depend mostly on its content of cells
   B. Cartilage extracellular matrix contains no collagen fibers
   C. Cartilage receives nutrients and oxygen via capillary networks located in the center of the tissue
   D. The territorial matrix stains more intensely basophilic than the interterritorial matrix since it contains the highest concentration of sulfated proteoglycans
32. Select the pair of terms that correctly completes the following statement.
In the hypophysis, the __1__ forms a sleeve around the __2__.

   __1__       __2__
   A. Median eminence   Pars nervosa
   B. Pars distalis      Hypothalamus
   C. Pars intermedia    Pars distalis
   D. Pars tuberalis     Infundibulum

33. Which of the following statements concerning appositional growth is true?
   A. Although cartilage can grow in this fashion, bone cannot
   B. It refers to the addition of new cells producing extracellular matrix at the edges of a piece of tissue such as cartilage
   C. It occurs exclusively at inner surfaces in a bone
   D. It refers to the addition of new cells producing extracellular matrix in the middle of cartilage tissue
   E. It refers to the replacement of a pre-existing cartilage model by bone

34. In the adrenal glands, medullary cells that are bathed by blood from cortical sinusoids are induced to:
   A. Develop structural properties of true neurons
   B. Secrete norepinephrine
   C. Convert norepinephrine to epinephrine
   D. Produce large secretory granules that have an eccentrically placed density

35. A 12-year-old boy brought to the ER presents with a "slipped capital femoral epiphysis" following a traumatic injury to the femur. What immediate concerns should you have regarding the continued development of the femur?
   A. Damage to the articular cartilage covering the femoral head may lead to arthritis
   B. Damage to surrounding blood vessels may lead to avascular necrosis of the secondary ossification center
   C. The primary ossification center may fail to develop, leading to an abnormally short femoral length
   D. Excessive interstitial growth of cartilage in the proximal epiphysis may lead to an abnormally elongated femur
36. While working on a pathology internship at the Philadelphia Coroners office, you are called to examine the body of an individual who has recently died under questionable circumstances. You notice immediately that the body is in a state of ‘rigor mortis.’ Which of the following accounts for this condition?
   A. Voltage gated calcium release channels close, preventing calcium release into the sarcoplasm of the skeletal muscle fibers
   B. Loss of communication between cells due to disruption of gap junctions
   C. Absence of ATP results in the continued attachment of myosin heads to binding sites on actin filaments
   D. Tropomyosin blocks a binding site on actin, preventing myosin from binding to actin filaments

37. Which of the following cells has microvilli at their apical ends, tight junctions between neighboring cells, mitochondria with shelf-like cristae and a well-developed golgi complex:
   A. Adrenal medullary cells
   B. Cells of the zona glomerulosa of the adrenal cortex
   C. Follicular cells of the thyroid gland
   D. Parafollicular cells of the thyroid gland

38. Diabetes insipidus (decreased ability to concentrate the urine) is most likely to result from:
   A. A prolactin-producing pituitary tumor derived from mammotrophs
   B. Failure of the pars intermedia to develop
   C. Lesions involving the supraoptic & paraventricular nuclei of the hypothalamus
   D. Obstructed blood flow through the hypophyseal portal veins

39. Which of the following is true concerning osteoclast development?
   A. Osteoclasts are derived from osteoprogenitor cells
   B. PTH receptors located on the developing osteoclasts stimulate their differentiation
   C. Osteoblasts can modulate the maturation of osteoclasts through the release of signaling molecules (e.g. RANK Ligand and osteoprotegerin)
   D. Osteoclasts differentiate into monocytes
   E. Osteoclast development and activity increase in the presence of calcitonin
40. Select the pair of terms that correctly completes the following statement.
In the pituitary, growth hormone is produced by __1__ in the __2__.

   1
A. Acidophils               B. Basophils               C. Chromophobes
D. Neurons                 E. Pituicytes

   2
A. Pars distalis           B. Pars intermedia
C. Pars tuberalis          D. Infundibulum
E. Pars nervosa

41. In which of the following locations do the cells characteristically contain large amounts of lipid that is usually extracted during routine histologic preparation, leaving the cytoplasm of the cells with a vacuolated appearance:

   A. Adrenal medulla
   B. Pars nervosa
   C. Thyroid follicle
   D. Zona fasciculata
   E. Zona glomerulosa

42. If you were examining sections of the normal parathyroid of a 12 year old boy, which of the following should you expect to find:

   A. Abundant white fat cells within the gland
   B. A cortex and a medulla
   C. Many small pale cells whose secretory granules stain positively for parathyroid hormone by immunofluorescence
   D. Many small follicles filled with colloid
   E. Numerous clusters of large eosinophilic cells

43. If you pushed a straight pin through your Course Director's arm into the bone, the pin would pass through all the numbered tissues & layers listed below. Which of the lettered choices places these structures in the correct order of penetration, going from the skin toward the bone marrow:

   1. Cellular periosteum
   2. Endosteum
   3. Fibrous periosteum
   4. Interstitial lamellae
   5. Outer circumferential lamellae

   A. 1-3-2-5-4
   B. 3-1-5-4-2
   C. 2-5-4-1-3
   D. 5-4-2-1-3
44. The foramen caecum of the adult tongue is a remnant from the development of:
   A. Inferior parathyroids
   B. Rathke's pouch
   C. Superior parathyroids
   D. Thyroid
   E. Ultimobranchial body

**DIRECTIONS:** Each of the numbered items or incomplete statements in this section is negatively phrased, as indicated by a capitalized word such as NOT, LEAST, or EXCEPT. Select the ONE lettered answer or completion that is BEST in each case.

45. Identify the FALSE statement concerning motor nerve endings/terminals on skeletal muscle fibers:
   A. Acetylcholine is the neurotransmitter
   B. Botulism is caused by inhibition of neurotransmitter release
   C. The synaptic cleft is wide so that multiple muscle fibers can respond to transmitter released from one nerve terminal
   D. The sarcolemma exhibits junctional folds
   E. Each muscle fiber is innervated by a single motor neuron

46. Identify the FALSE statement. Muscle spindles:
   A. Contain modified skeletal muscle fibers called intrafusal fibers
   B. Are stimulated by strong contraction of the muscle in which they lie, rather than by stretch of that muscle
   C. Receive motor innervation that regulates the sensitivity of the spindle
   D. Are a type of encapsulated sensory receptor
   E. Include nuclear bag fibers, which contain an aggregation of nuclei in the expanded midregion of the cell

47. Which of these statements concerning woven bone is FALSE?
   A. It is usually produced rapidly
   B. It is stronger than lamellar bone
   C. It is more cellular than lamellar bone
   D. It may be present in both cortical and cancellous bone
   E. Its cells and collagen fibers are randomly oriented
48. Identify the **FALSE** statement. Osteoprogenitor cells:
   A. Are derived from mesenchymal cells
   B. Are uninucleate cuboidal cells with a highly basophilic cytoplasm
   C. Can be found in the cellular layer of the periosteum
   D. Can be found in the endosteum
   E. When activated, can divide & produce osteoblasts

49. Identify the **FALSE** statement regarding fibrocartilage:
   A. Fibrocartilage is found in the anulus fibrosus of an intervertebral disk
   B. Fibrocartilage makes up most of the fetal skeleton prior to ossification
   C. The chondrocytes are often arranged in rows between bundles of collagen fibers
   D. The matrix is eosinophilic due to the abundance of collagen
   E. Type I collagen is the most abundant type of collagen in the matrix of fibrocartilage

50. Each the following is true of cardiac muscle cells **EXCEPT**:
   A. They form gap junctions
   B. They form intercalated discs
   C. The cells may be branched
   D. Each cell is innervated by a single axon
   E. They contain Z-lines

**PART II:**
**MATCHING:** These sets of matching questions consist of a list of lettered options followed by several numbered items. For each numbered item, select the ONE lettered option that is most closely associated with it. Each lettered option may be used **once, more than once, or not at all.**

- A. Skeletal Muscle
- B. Smooth Muscle
- C. Cardiac Muscle
- D. Both A and C
- E. Both B and C

51. Individual cells are a structural syncytium that arose from the fusion of myoblasts
52. Muscle fibers have T-tubules
53. Muscle fibers have centrally located nuclei
54. Contraction is regulated by Ca$^{++}$-calmodulin complex
55. Cells contain numerous diads
MICROSCOPIC ANATOMY

A. Dorsal root ganglion neuron
B. Schwann cell
C. Motor neuron of the voluntary (somatic) nervous system
D. Microglia
E. Neuron of the enteric nervous system
F. Astroglia
G. Postganglionic sympathetic neuron
H. Oligodendrocytes
I. Satellite cells
J. Ependymal cells

56. Pseudounipolar neuron
57. Multipolar neuron found in the spinal cord
58. Provides motor innervation to smooth muscle in a blood vessel in the dermis
59. Provides myelin to portions of many axons

A. Articular cartilage
B. Synovial membrane
C. Epiphyseal growth plate
D. Synovial fluid
E. Fibrocartilage
F. Elastic cartilage
G. Sutural ligament

60. Tissue type found interspersed with hyaline cartilage in a symphysis
61. Cartilage that receives its nutrition from synovial fluid
62. This lines the non-articular surfaces of a diarthrodial joint cavity
63. A type of synchondrosis
64. A tissue type that is covered by a perichondrium

A. Intramembranous bone formation
B. Endochondral bone formation
C. Both
D. Neither

65. Periosteal bone collar formation occurs by this process
66. Involves zones of proliferation, hypertrophy, and calcification
67. Ultimate origin is from mesenchymal condensation
MATCHING: For each of the numbered items below, choose the most appropriate response from the lettered structures on the diagram. Each lettered choice on the diagram may be used once, more than once or not at all.

68. Ending of the pathway that utilizes thyroid peroxidase
69. Beginning of the pathway that results in the synthesis of thyroglobulin