

Anatomy C - Anatomy_C_Final - UT Invitational 2020 - Division C - 11-08-2020**Exam Authors:**

1. Mahija Ginpallli, *University of Texas at Austin, B.S.A. Neuroscience '22*
2. Sophia Velasco, *University of Florida, B.S. Biochemistry and Psychology '23*
3. Kevin Hao, *University of Florida College of Medicine, M.D. '24*

Hello, all! Welcome to the virtual **Anatomy and Physiology C Exam** offered by the **2020 UT Invitational!** Please read the instructions and expectations below:

- The rules for this event have been adapted for our virtual tournament and follow the **2020-2021 Regional Rules**.
- This exam is composed of multiple-choice (MC), multiple select and fill-in-the-blank questions. Therefore, partial credit is scarce, so make sure to choose wisely!
- For fill-in-the-blank questions, the capitalization of the answers (e.g., Answer vs. answer) will **NOT** be considered (i.e., both answers will be accepted). However, incorrect spelling and unnecessary spaces before/after the answers will lead to an **incorrect** answer. Keep this in mind!
- For answers involving **letters** (e.g., A, B, C), do **NOT** include the period. For example, if the answer is A, do **NOT** enter "A." and enter "A" instead.
- If you have any questions or concerns regarding this exam, feel free to contact the authors through the following emails: mginjupalli@utexas.edu, velasco.scienceolympiad@gmail.com, and kevin@floridascienceolympiad.org.
- Three authors worked on this exam. The following acronyms refer to the corresponding question author (**MG** - Mahija, **SV** - Sophia, **KH** - Kevin). Please email your questions to the correct author! :)

Good luck!

I. Integumentary System

(MG + SV) Multiple Choice: Choose the most appropriate answer option for the following questions. Each question is worth **one** point.

1. (1.00 pts) Thick skin has all of the following except:

- ☐ A) Stratum corneum
- ☐ B) Sweat glands
- ☐ C) Sebaceous glands
- ☐ D) Stratum disjunctum

2. (1.00 pts) Which of the following are dendritic cells of the skin and mucosa that contain large granules?

- ☐ A) Langerhans cells
- ☐ B) Melanocytes
- ☐ C) Meissner cells
- ☐ D) Merkel discs
- ☐ E) None of the above

3. (1.00 pts) Which term describes the ability of a system or living organism to adjust its internal environment in order to maintain a stable equilibrium?

- ☐ A) Evaporation
- ☐ B) Transpiration
- ☐ C) Homeostasis
- ☐ D) Vasoconstriction
- ☐ E) None of the above

4. (1.00 pts) Which of the following skin receptors detects pain?

- ☐ A) Nociceptors
- ☐ B) Thermoreceptors
- ☐ C) Mechanoreceptors
- ☐ D) All of the above
- ☐ E) None of the above

5. (1.00 pts) Choose the correct statement regarding **vitamin D** and the integumentary system's role in producing this vitamin.

- ☐ A) Vitamin D decreases the intestinal absorption of calcium, iron, magnesium, phosphate, and zinc.
- ☐ B) Vitamin D₃ is made in the skin when 7-dehydrocholesterol has a reaction with UV light.
- ☐ C) Vitamin D is produced in the 3 innermost epidermis strata.
- ☐ D) A and B
- ☐ E) All of the above
- ☐ F) None of the above

6. (1.00 pts) Choose the correct statement regarding the blood supply of the integumentary system.

- ☐ A) The papillary region of the dermis contains papillae that extend toward the dermis and contain terminal capillary networks.
- ☐ B) The epidermis contains few blood vessels, whereas the dermis contains a lot of blood vessels.
- ☐ C) Blood vessel control plays a key role in thermoregulation.
- ☐ D) A and B
- ☐ E) All of the above
- ☐ F) None of the above

7. (1.00 pts) Apocrine sweat glands can be found in all of the following **except**:

- ☐ A) axillae
- ☐ B) ear canal
- ☐ C) perianal region
- ☐ D) external genitalia
- ☐ E) areola
- ☐ F) All of the above are correct.

8. (1.00 pts) Blisters form as a result of damaged blood vessels from burns or excessive friction. Where does the serous fluid that seeps out from these vessels accumulate?

- ☐ A) Within the dermis
- ☐ B) Within the epidermis
- ☐ C) Between the dermis and epidermis
- ☐ D) Between the dermis and hypodermis

9. (1.00 pts) People of different skin colors possess the same number of melanocytes. Despite this, why do some individuals have darker skin than others?

- ☐ A) Their melanocytes provide more melanin
- ☐ B) Their melanin granules are not tightly clustered
- ☐ C) Their melanin breaks down more slowly
- ☐ D) All of the above

10. (1.00 pts) Too much UV may result in [BLANK] while too little may result in [BLANK].

- ☐ A) Infertility; Spina bifida
- ☐ B) Spina bifida; Rickets
- ☐ C) Osteoporosis; Infertility
- ☐ D) Spina bifida; infertility

11. (1.00 pts) Women worldwide have skin averaging 4% lighter than men do. Why might this be?

- ☐ A) Greater need for vitamin D and calcium
- ☐ B) Lesser need for vitamin D and calcium
- ☐ C) Greater population proportions in climates without excessive UV exposure
- ☐ D) None of the above

12. (1.00 pts) Vellus hair forms in which of the following locations on a child?

- ☐ A) Scar tissue
- ☐ B) Back of the ear
- ☐ C) Eyelashes
- ☐ D) Back

13. (1.00 pts) All of the following occurs during the anagen phase of the hair cycle except:

- ☐ A) Stem cells multiply
- ☐ B) Sheath cells synthesize keratin
- ☐ C) Club hair moves up the follicle
- ☐ D) Hair cells die

14. (1.00 pts) All of the following occurs during the catagen phase of the hair cycle except:

- ☐ A) Sheath cells die
- ☐ B) Club hair loses anchorage
- ☐ C) Follicle grows larger
- ☐ D) Base of the hair keratinizes

15. (1.00 pts) All of the following occurs during the telogen phase of the hair cycle except:

- ☐ A) Follicle grows larger
- ☐ B) Club hair forms
- ☐ C) Club hair loses anchorage
- ☐ D) All of the above

16. (1.00 pts) Which of the following is true about sebaceous glands?

- ☐ A) They create the vernix caseosa
- ☐ B) Areolar glands are a form of sebaceous glands
- ☐ C) Fordyce spots are malignant forms of sebaceous glands
- ☐ D) None of the above

17. (1.00 pts) Which of the following is true about the reticular layer?

- ☐ A) It is composed of collagen fibers (type II) that run parallel to the skin
- ☐ B) It is composed of collagen fibers (type II) that don't run parallel to the skin
- ☐ C) It is composed of collagen fibers (type I) that run parallel to the skin
- ☐ D) It is composed of collagen fibers (type I) that don't run parallel to the skin

18. (1.00 pts) Which of the following organisms is not part of the normal flora of the skin?

- ☐ A) Staphylococcus epidermidis
- ☐ B) Staphylococcus aureus
- ☐ C) Escherichia coli
- ☐ D) Candida albicans

19. (1.00 pts) A patient shows up at your office with each of the following conditions. Which do you think require immediate action/assessment?

- ☐ A) Patchy redness on the face and neck
- ☐ B) Blue-tinged earlobes and lips
- ☐ C) Lower back and stomach sporting brown spots
- ☐ D) Skin and eye sclera appear slightly yellow

20. (1.00 pts) Myoepithelial cells are found in:

- ☐ A) Active mammary gland acini
- ☐ B) Inactive mammary gland ducts
- ☐ C) Eccrine sweat gland acini
- ☐ D) All of the above

21. (1.00 pts) A definitive diagnosis of herpes zoster can be made through which of the following diagnostic tests?

- ☐ A) Patch test
- ☐ B) Skin biopsy
- ☐ C) Lesion culture
- ☐ D) Wood's light exam

22. (1.00 pts) When assessing a lesion hypothesized to be malignant melanoma, what might you expect to find?

- ☐ A) A firm, nodular lesion with a crust
- ☐ B) A papule with a waxy border and central crater
- ☐ C) An irregularly shaped lesion
- ☐ D) A large papule with a rough scale

23. (1.00 pts)

Hemoglobin imparts red color to skin tone. Oxygen deficiency turns hemoglobin (Hg) into a red-violet color. Why, then, do individuals with cyanosis appear to have blue-violet skin?

- ☐ A) White dermal collagen lightens Hg red-violet
- ☐ B) Processing of visual input by visual cortex
- ☐ C) Light scattering properties of skin
- ☐ D) All of the above

24. (1.00 pts) A female patient reports to your office with burning, itching skin, and white patches in her mouth. What is your diagnosis?

- ☐ A) Shingles
- ☐ B) Erysipelas
- ☐ C) Eczema
- ☐ D) Candidiasis

25. (1.00 pts) Why are first- and second-degree burns known as "partial-thickness burns?"

- ☐ A) They leave some of the epidermis intact
- ☐ B) They leave some of the dermis intact
- ☐ C) They leave some of the hypodermis intact
- ☐ D) They leave some of the reticular layer intact

26. (1.00 pts) Which of the following is not true about Psoriasis?

- ☐ A) It can be autoimmune
- ☐ B) It cannot recur
- ☐ C) It shows as reddened plaques covered by a silvery scale
- ☐ D) It runs in families

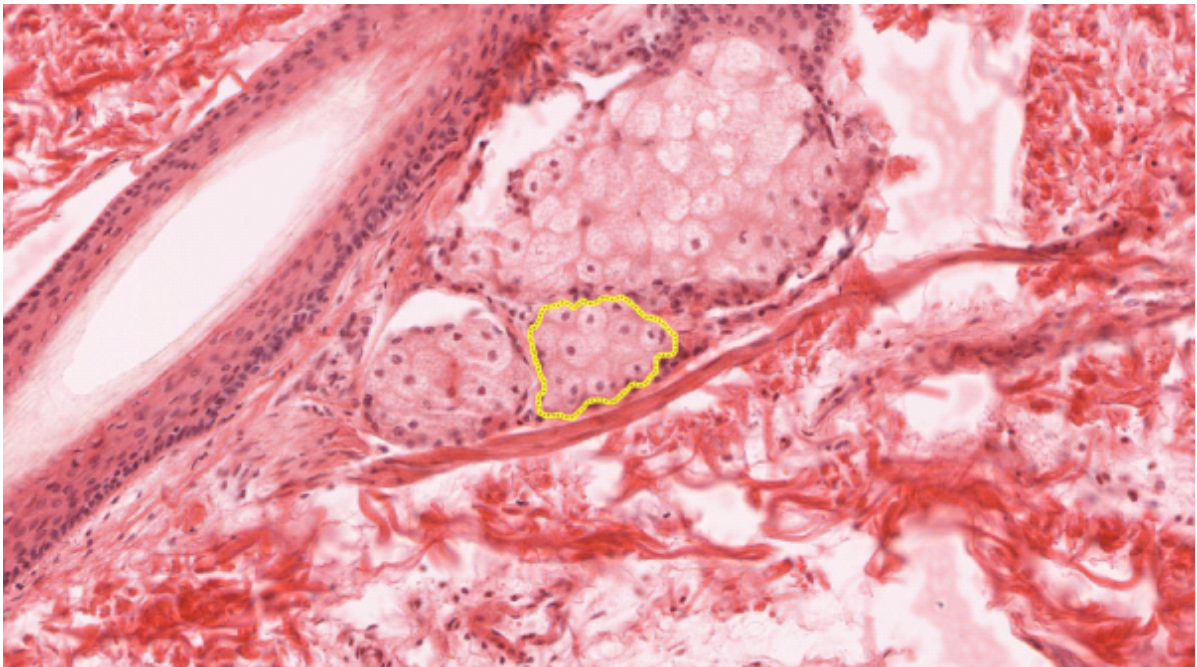
27. (1.00 pts) Corns and calluses are not the same things. Which answer choice refers to a **callus**?

- ☐ A) Tend to develop on parts of the feet that do not bear weight
- ☐ B) Painful when pressed
- ☐ C) Hard center surrounded by inflamed skin
- ☐ D) Usually develop on the soles of the feet

28. (1.00 pts) Which is a **risk factor** that increases a person's risk for calluses?

- ☐ A) Hammer toe
- ☐ B) Bunions
- ☐ C) Other foot deformities
- ☐ D) No hand protections
- ☐ E) All of the above
- ☐ F) None of the above

(SV) Histology: The following questions refer to the structure surrounded by a yellow outline. Point values for each question will be denoted. **Spelling counts! (10)**



29. (1.00 pts) The yellow outline encloses secretory cells of what type of integumentary gland? (*Hint: Your answer must be one word.*) (1)

30. (2.00 pts) Does this type of gland secrete a lipid-rich or lipid-poor substance? (*Answer choices: rich or poor.*) (2)

31. (2.00 pts) What is the name of the substance secreted by this cell? (2)

32. (2.00 pts) The substance secreted by this cell is secreted in what manner? (*Answer choices: eccrine, merocrine, holocrine*) (2)

33. (1.00 pts) **True or False:** The integumentary gland that has these secretory cells are located in the palms of the hands and soles of the feet. (1)

☐ True ☐ False

34. (1.00 pts) **True or False:** The integumentary gland that has these secretory cells also protects the body against microorganisms. (1)

☐ True ☐ False

35. (1.00 pts) **True or False:** The integumentary gland that has these secretory cells release acids. (1)

☐ True ☐ False

II. Skeletal System

(MG) Multiple Choice: Choose the most appropriate answer option for the following questions. Each question is worth **one** point.

36. (1.00 pts) Which of the following is not a purpose/function of the musculoskeletal system?

- ☐ A) Supporting the body and allowing motion
- ☐ B) Protecting vital organs
- ☐ C) Storage of hematopoietic system and fat storage
- ☐ D) Main storage system for calcium
- ☐ E) Main storage system for phosphorus
- ☐ F) All of the above are purposes/functions of the musculoskeletal

37. (1.00 pts) Choose the correct statement regarding the red bone marrow.

- ☐ A) An alternative name is the medulla ossium rubra.
- ☐ B) Red marrow consists mainly of hematopoietic tissue.
- ☐ C) Red marrow gives rise to only red blood cells and platelets.
- ☐ D) A and B
- ☐ E) A and C
- ☐ F) None of the above

38. (1.00 pts) Three types of muscle tissue exist in the body: skeletal, smooth, and cardiac muscle. Choose the correct statement regarding these muscle tissues.

- ☐ A) Skeletal and smooth muscle is involved in body locomotion.
- ☐ B) Smooth muscle can be found in intestinal walls and the heart.
- ☐ C) Cardiac and smooth muscle are involved in involuntary movement.
- ☐ D) A and B
- ☐ E) All of the above
- ☐ F) None of the above

39. (1.00 pts) Why might the total number of bones in a body vary among adults?

- ☐ A) Bones known as sesamoid bones form within tendons in response to stress
- ☐ B) Some individuals may have extra sutural bones
- ☐ C) Childhood bone fusion, such as within the pelvic girdle, differs from person to person
- ☐ D) A & B are correct
- ☐ E) All of the above are correct

40. (1.00 pts) What is the difference between a trochanter and a tuberosity?

- ☐ A) A trochanter is a process unique to the femur
- ☐ B) Tuberosities are smooth while trochanters are rough
- ☐ C) Trochanters are rugose while tuberosities are smooth
- ☐ D) None of the above

41. (1.00 pts)

Bow hunter syndrome (BHS) is an uncommon cause of vertebrobasilar insufficiency that results from compression of the vertebral artery (VA) upon head rotation. Based on this, you can conclude that this artery runs upward through the [BLANK] processes of the [BLANK] vertebrae.

- ☐ A) Spinous; thoracic
- ☐ B) Transverse; cervical
- ☐ C) Spinous; cervical
- ☐ D) Transverse; thoracic

42. (1.00 pts) Which of the following structures do not transmit through the foramen magnum of the occipital bone?

- ☐ A) Spinal cord

- ☐ B) Accessory nerve
- ☐ C) Trigeminal nerve
- ☐ D) Vertebral arteries

43. (1.00 pts) T/F: Some people do not possess a visible frontal sinus on their frontal bone due to the calvaria being cut too high to show it.

- ☐ True ☐ False

44. (1.00 pts) The greater and lesser wings of the sphenoid bone can best be seen from a [BLANK] perspective:

- ☐ A) Superior
- ☐ B) Ventral
- ☐ C) Posterior
- ☐ D) Medial

45. (1.00 pts) Kyphosis is otherwise known as [BLANK] while lordosis is otherwise known as [BLANK]

- ☐ A) Swayback; hunchback
- ☐ B) Hunchback; swayback
- ☐ C) Hollowback; Gibbus deformity
- ☐ D) Gibbus deformity; hunchback

46. (1.00 pts) Each rib articulates with:

- ☐ A) Inferior costal facet of the lower vertebra
- ☐ B) Superior costal facet of the upper vertebra
- ☐ C) Inferior costal facet of the upper vertebra
- ☐ D) None of the above

47. (1.00 pts) Fibers anchoring the periosteum to compact bone are known as:

- ☐ A) Osteogenic fibers
- ☐ B) Volkmann fibers
- ☐ C) Periosteal fibers
- ☐ D) Sharpey's fibers

48. (1.00 pts) The humerus articulates with the scapula at the:

- ☐ A) Lateral border
- ☐ B) Humeral cavity
- ☐ C) Glenoid cavity
- ☐ D) Acromion

49. (1.00 pts) Ribs [BLANK] are true, [BLANK] are false, and [BLANK] are false, floating.

- ☐ A) 1-7 ; 8-10 ; 11-12
- ☐ B) 1-7 ; 7-9 ; 10-12
- ☐ C) 1-6 ; 7-10 ; 11-12
- ☐ D) 1-7 ; 8-19 ; 10-12

50. (1.00 pts) Male pelvic girdles [BLANK] while female pelvic girdles [BLANK]

- ☐ A) Are round or oval; are heart-shaped
- ☐ B) Face slightly anteriorly; face more laterally
- ☐ C) Are wider and shallower; Are narrower and deeper
- ☐ D) Are less moveable; are more moveable

51. (1.00 pts) Which of the following sites are commonly chosen for adult bone marrow biopsies?

- ☐ A) Sternum
- ☐ B) Diploe
- ☐ C) Diaphysis
- ☐ D) Humeral head

52. (1.00 pts) Which of the following disorders causes fusion of the bones at the joints?

- ☐ A) Rheumatoid arthritis
- ☐ B) Gout
- ☐ C) Osteoporosis
- ☐ D) Osteoarthritis

53. (1.00 pts) Bones retain a weight into adulthood that allows normal body function - how does the skeletal system achieve this?

- ☐ A) Osteoblasts secrete HCl and compounds with similar functional groups to break down the matrix
- ☐ B) Osteoblasts form new canaliculi in order to reduce total bone weight
- ☐ C) Osteocytes produce new depressions in the bone (aka lacunae) to house other bone cells
- ☐ D) The inner sheets of the matrix are broken down by osteocytes found in the medullary cavity

54. (1.00 pts) A skater falls, twists his left knee inwards, and feels pain at the inner side of his knee. Based on this description, which ligament was torn?

- ☐ A) ACL
- ☐ B) PCL
- ☐ C) LCL
- ☐ D) MCL

55. (1.00 pts)

Imagine you're a researcher examining a bone cell under the microscope. You notice that it's in the process of cytokinesis and determine that the cell is most likely a...

- ☐ A) Osteoclast
- ☐ B) Osteoblast
- ☐ C) Osteocyte
- ☐ D) None of the above

56. (1.00 pts) Which of the following is not a compound that can commonly be found within the bone matrix?

- ☐ A) Transforming growth factor
- ☐ B) Insulin-like growth factor
- ☐ C) Hydroxyapatite
- ☐ D) Vitamin D

57. (1.00 pts) Which of the following bones can be found in the foot rather than the hand?

- ☐ A) Trapezium
- ☐ B) Cuboid
- ☐ C) Triquetrum
- ☐ D) Pisiform

58. (1.00 pts) Interstitial cartilage growth is defined as or characterized by...

- ☐ A) Chondroblasts undergoing mitosis and producing new matrix on cartilage's outer surface.
- ☐ B) Chondrocytes undergoing mitosis and producing new matrix inside the inner area of cartilage.
- ☐ C) It grows from the outside inwards.
- ☐ D) Perichondrial cells maturing into chondrocytes.

Multiple select: The following questions are multiple-select. Choose all of the correct answers!

59. (1.00 pts) Which are the primary divisions of the axial skeletal system?

(Mark **ALL** correct answers)

- ☐ A) Head
- ☐ B) Vertebral column
- ☐ C) Thorax
- ☐ D) Metatarsals
- ☐ E) Pelvis

60. (1.00 pts) Which are divisions of the appendicular skeleton?

(Mark **ALL** correct answers)

- ☐ A) Pectoral girdles

- ☐ B) Pelvis
- ☐ C) Thighs and legs
- ☐ D) Feet and ankles
- ☐ E) Vertebral column
- ☐ F) Rib cage

(SV) Identification: Determine which type of vertebrae is described based on the provided details. Each question is worth **one** point. Your answer options are **cervical, thoracic, and lumbar**. (10)

61. (1.00 pts) Flattened anterior and posterior surfaces; equal depth.

62. (1.00 pts) These are the largest segments of the vertebral column and characterized by the absence of the foramen transversarium within the transverse processes.

63. (1.00 pts) Small and circular intervertebral foramen, with two at each intervertebral level.

64. (1.00 pts)

The 1st vertebrae of this type have superior articular surfaces that are directed upward and backward and a spinous process that is thick, long, and almost horizontal.

65. (1.00 pts) Pedicles are oriented laterally and backward.

66. (1.00 pts) The superior articular facet is flat, oval, and faces backward

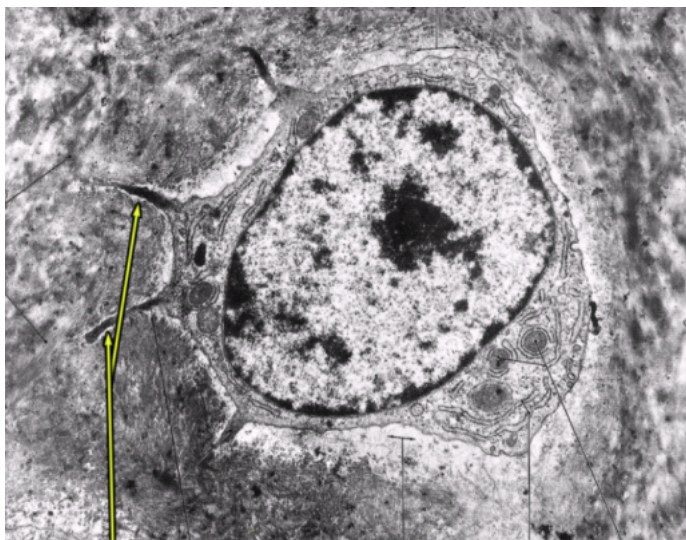
67. (1.00 pts) The 8th vertebrae of this type (along with the 9th) are at the same level as the xiphisternum.

68. (1.00 pts) Most individuals have five of these vertebrae type.

69. (1.00 pts) The transverse processes of this type are long and slender.

70. (1.00 pts) The anterior tubercle of the 6th vertebra of this type is called the Chassaignac tubercle.

(SV) **Histology Part I:** The arrow below points to a **specific structure** in the bone. Identify this structure, then determine if the following statements about this structure are **true or false**. Each answer is worth **one** point! (8)



71. (1.00 pts) Identify this structure.

72. (1.00 pts) Osteocytes do not fill up this structure entirely.

☐ True ☐ False

73. (1.00 pts) Another term for this structure is "canals of Havers."

☐ True ☐ False

74. (1.00 pts) This structure runs at an obtuse angle to the Haversian canals.

☐ True ☐ False

75. (1.00 pts) Canaliculi radiate from this structure.

☐ True ☐ False

76. (1.00 pts) This structure is located between the lacunae of ossified bone.

☐ True ☐ False

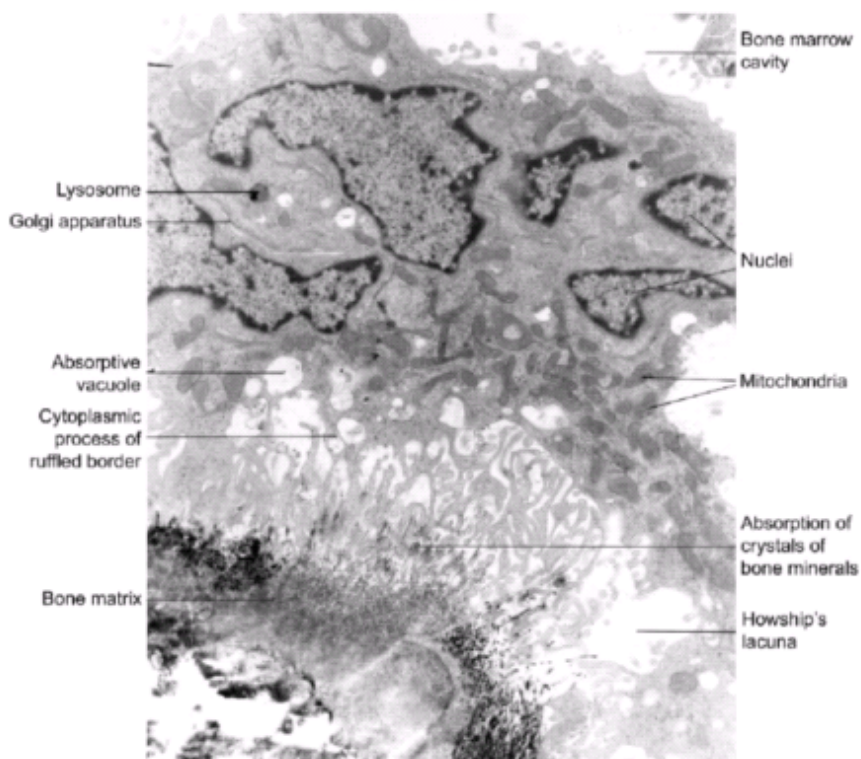
77. (1.00 pts) Filopodia project into this structure.

☐ True ☐ False

78. (1.00 pts) This structure transmits blood vessels from the periosteum into the bone.

☐ True ☐ False

(SV) Histology Part II: Answer the following questions based on the provided image. Point values are provided for each question. **Spelling counts! (13)**



79. (1.00 pts) Identify the cell type shown in the provided image. (1)

80. (2.00 pts)

Degenerative skeletal diseases such as osteoporosis become more prevalent as Americans live longer. Based on this statement, predict if the activity of the cell in the image has been improved or impaired (*Answer choices: improved or impaired*). (2)

81. (2.00 pts) The cell in the image is derived from which type of cell? (*Hint: This cell is also located in the bone.*) (2)

82. (1.00 pts) **True or False:** This cell type can create clastokines, which can then recruit certain progenitors and promote cell proliferation and differentiation. (1)

☐ True ☐ False

83. (2.00 pts) This cell type also plays a key role in regulating a signaling ion store in the bone. State the full name of this ion. (2)

84. (1.00 pts) **True or False:** IGF-1 and TGF- β are incorporated into the bone matrix and released by this cell. (1)

☐ True ☐ False

85. (2.00 pts) In normal circumstances, do you expect to find this cell type on the bone surface or inside the bone? (*Answer choices: surface or inside*) (2)

86. (2.00 pts)

Complete the sentence: The _____ of this cell type allows for directed transport of acidified cytoplasmic vesicles toward the bone-apposed plasma membrane (including the ruffled border). (2)

(SV) Pathology: Determine the disease/disorder shown in the provided X-rays and MRIs. Be as specific as possible and use the names provided in the **rules** (**Example:** Do not input "ACL tear". Input "anterior cruciate ligament tear"). Each image is worth **two** points. (16)

87. (2.00 pts)



88. (2.00 pts)



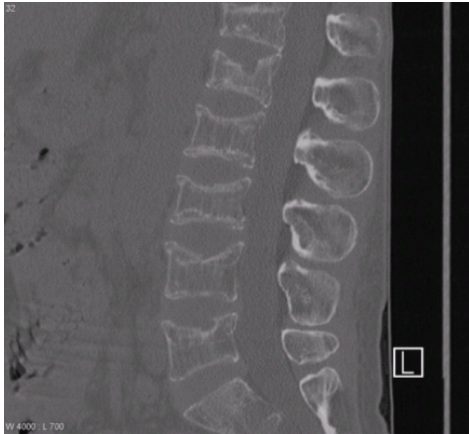
89. (2.00 pts)



90. (2.00 pts)



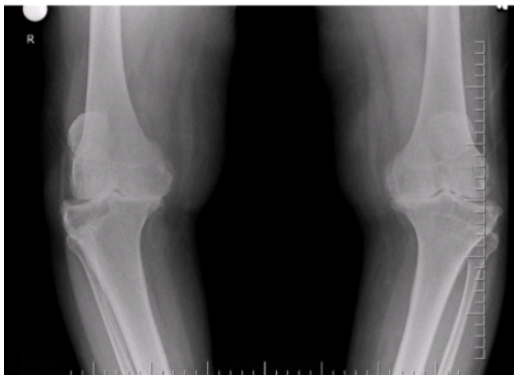
91. (2.00 pts)



92. (2.00 pts)



93. (2.00 pts)



94. (2.00 pts)

**III. Muscular System**

(SV) Multiple Choice: Choose the most appropriate answer option for the following questions. Then, type in the correct letter (**Options:** A, B, C, D, E, F.) You do **not** need to type the letter for the **last five MC questions**. Each question is worth **one** point.

95. (1.00 pts)

Which of the following statements regarding the neuronal innervation of skeletal muscle is **true**?

- a. It only consists of motor nerve fibers and the neuromuscular junction.
- b. The nerve fibers innervating skeletal muscles are only myelinated.
- c. The neuron cell bodies result in large, generally branched axons that travel to the corresponding target muscle.
- d. The motor nerve terminal has a high amount of mitochondria, endoplasmic reticulum, and ACh.

96. (1.00 pts)

Which of the following has a high concentration of neurotransmitter receptors (AChR)?

- a. The presynaptic membrane of the muscle fiber
- b. The postsynaptic membrane of the muscle fiber
- c. A and B
- d. None of the above

97. (1.00 pts)

The central M line of the sarcomere is attached to which protein?

- a. Actin
- b. Myosin
- c. Titin
- d. Tropomyosin

98. (1.00 pts)

Which regulatory protein plays a role in the myofilament sliding mechanism?

- a. Troponin I
- b. Troponin T
- c. Troponin C
- d. A and B
- e. B and C

- f. A, B, C
- g. None of the above

99. (1.00 pts) Choose the **true** statement regarding blood supply and lymphatics of the muscular system.

- a. The primary artery that supplies the skeletal muscle courses parallel to the longitudinal axis of the muscle fiber.
- b. Secondary arteries lead to tributaries called feed arteries, which are perpendicular to the secondary artery.
- c. Transverse arterioles are final vascular branches that perfuse capillaries in the endomysium.
- d. Lymphatic capillaries originate in skeletal muscle in the microvascular unit within the perimysium.

100. (1.00 pts) Choose the true statement regarding cardiac muscle and its characteristics.

- a. Pacemaker cells in the AV node are responsible for cardiac muscle contraction.
- b. The Purkinje fibers trigger action potentials that lead to sodium and potassium influx in addition to calcium release from the SR.
- c. Cardiac muscle does not contract as a single unit.
- d. Cardiac muscle is triggered by calcium binding to troponin in the actin filaments of the cardiomyocyte (similar to the skeletal muscle mechanism)

101. (1.00 pts) Skeletal muscle constitutes approximately what percent of the total human body weight?

- a. 20%
- b. 40%
- c. 60%
- d. 73%

102. (1.00 pts) Which of the following is a characteristic of multi-unit smooth muscles?

- a. Also referred to as visceral muscle, multi-unit smooth muscle is the most common type in the human body.
- b. Produces slow, steady contractions (e.g. digestive system).
- c. Smooth muscle type that is not electrically coupled due to lack of gap junctions.
- d. Forms the walls of hollow organs.

103. (1.00 pts) Smooth muscle can be found in all of the following **except**:

- a. Erector pili muscle
- b. Iris
- c. Urinary bladder
- d. Pronator teres

104. (1.00 pts) Which proteins are considered to be the main proteins involved in smooth muscle contraction?

- a. Actin and myosin
- b. Actin and tropomyosin
- c. Troponin and myosin
- d. Titin and actin

105. (1.00 pts) All are functions of smooth muscle in the human body **except**:

- a. Regulation of blood flow and pressure through vascular resistance
- b. Regulation of bronchiole diameter
- c. Propulsion of sperm
- d. Flexion of the arm

106. (1.00 pts) Nitric oxide (NO) plays a role in smooth muscle relaxation. Which of the following correctly describes NO's role in smooth muscle relaxation?

- a. NO induces the conversion of GDP to cGMP.
- b. NO induces the conversion of GTP to GDP.
- c. An increase in cGMP stimulates cGMP-dependent protein kinase.
- d. A decrease in cGMP stimulates cGMP-dependent protein kinase.

107. (1.00 pts)

Which of the following is a step in the excitation-contraction coupling of skeletal muscles?

- a. Depolarization of T tubules leads to a conformational change in the dihydropyridine receptors, causing nearby ryanodine receptors on SR to open.
- b. Myosin dissociates from actin when ADP binds to an ADP binding domain on the myosin head.
- c. Depolarization of skeletal muscle is spread via T tubules. However, not the entire muscle fiber is depolarized.
- d. When calcium is released from the sarcoplasmic reticulum, it binds to troponin T.

108. (1.00 pts) Calcium enters the smooth muscle cell via which mechanism?

- a. Voltage-gated calcium channels activated by membrane depolarization.
- b. Norepinephrine and angiotensin II increase intracellular inositol triphosphate IP₃ (via the phospholipase-C pathway).
- c. Hormones or neurotransmitters opening ligand-gated channels are differently located on the cell membrane.
- d. A and B
- e. B and C
- f. A, B, C

109. (1.00 pts)

Exercise can lead to muscle cramps, which result in continuous, painful, and localized contraction of a muscle group. Which of the following statements about muscle cramps are correct?

- a. A painful cramp contraction limited to a specific area means that the cause of the cramp is also local.
- b. Palpating the muscle area affected by the cramp will not present a knot.
- c. The specific etiology of exercise-associated muscle cramps has been discovered.
- d. Cramps can last for minutes to a few seconds.
- e. More than one of the above

110. (1.00 pts) Which of the following is considered to be an environmental factor that triggers immune-mediated processes in inflammatory myopathies?

- a. Ultraviolet light
- b. Drugs and infection

- c. Vitamin A deficiency
- d. *HLA DRB1* *0301
- e. More than one of the above
- f. None of the above

111. (1.00 pts) Which is part of the Peter/Bohan criteria, the criteria most commonly used for polymyositis and dermatomyositis (PM/DM)?

- a. Myopathic changes in electromyography (EMG)
- b. Dermatomyositis rash (associated with diabetes mellitus)
- c. Lowered serum muscle enzymes
- d. Asymmetric proximal muscle weakness
- e. A, B
- f. B, C
- g. C, D
- h. A, B, C
- i. A, B, C, D

112. (1.00 pts) Which of the following tendons are prone to a higher possibility of injury (according to statistical data)?

- a. Rotator cuff
- b. Tibialis posterior
- c. Patellar tendons
- d. A, B
- e. B, C
- f. A, C
- g. A, B, C

113. (1.00 pts) Choose the **correct** statement regarding Achilles ruptures.

- a. Typically occur in the highly vascularized region.
- b. 8 cm - 10 cm to the osteotendinous junction.
- c. Tendinopathies often follow Achilles ruptures.
- d. A and B
- e. B, C
- f. A, B, C
- g. None of the above

114. (1.00 pts) Select the answer option that matches muscle injury classifications with the **correct** descriptions and/or examples.

- a. Grade I - mild sprains, edema, and ecchymosis
- b. Grade II - loss of function and gaps
- c. Grade III - severe bruises, complete rupture, and extensive hematoma
- d. A, B
- e. B, C
- f. A, B, C
- g. None of the above

115. (1.00 pts) What is a muscle that acts as an opposing muscle, usually contracting as a means of returning the limb to its original resting position?

- ☐ A) Agonist
- ☐ B) Antagonist
- ☐ C) Synergist
- ☐ D) A and B
- ☐ E) None of the above

116. (1.00 pts) In the action of forearm flexion by the biceps brachii, which would be the prime mover?

- ☐ A) Triceps brachii
- ☐ B) Biceps brachii
- ☐ C) Brachioradialis
- ☐ D) Brachialis
- ☐ E) Rotator cuff
- ☐ F) None of the above

117. (1.00 pts) What is the sheet of connective tissue lying below the fascia and also surrounding a muscle?

- ☐ A) Epimysium
- ☐ B) Endomysium
- ☐ C) Fascicle
- ☐ D) Perimysium

118. (1.00 pts) Which of the following is the continuation of the epimysium into the muscle, splitting fibers into fascicles?

- ☐ A) Fascia
- ☐ B) Endomysium
- ☐ C) Perimysium
- ☐ D) None of the above

119. (1.00 pts) Which **lever class** can be described by the following statement: load between force and pivot.

- ☐ A) first
- ☐ B) second
- ☐ C) third
- ☐ D) fourth
- ☐ E) All of the above

120. (1.00 pts) What is the term for the movable point of attachment for a muscle?

- ☐ A) Extension
- ☐ B) Abduction
- ☐ C) Adduction
- ☐ D) Insertion

- ☐ E) Origin
- ☐ F) None of the above

(SV) Matching: Match the following muscles with the correct **insertion**. Type in the corresponding **LETTER** in your answer sheet (*Example: If the answer is a, type in "a" and do not include a period.*) Each question is worth **one** point. **(10)**

Choices:

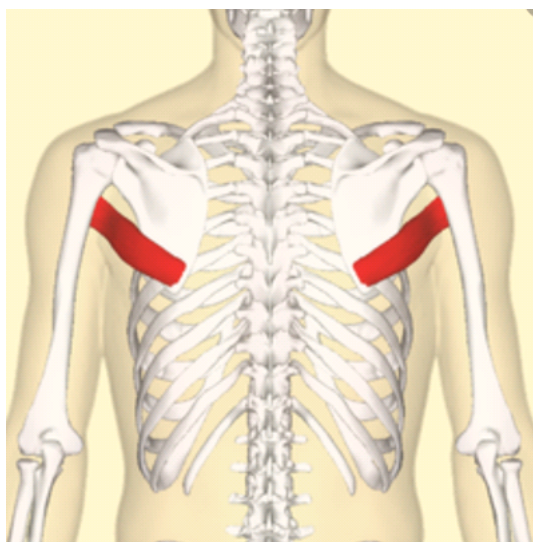
- a. Fifth metatarsal bone
- b. Iliotibial tract
- c. Tibia
- d. Orbicularis oris fibers
- e. Ramus of the mandible
- f. Coronoid process of the ulna
- g. Quadriceps tendon
- h. The middle facet of the greater tubercle of the humerus
- i. The medial lip of the intertubercular sulcus of the humerus
- j. Palmar aponeurosis and flexor retinaculum of the hand

121. (1.00 pts) Vastus intermedius

122. (1.00 pts) Palmaris longus

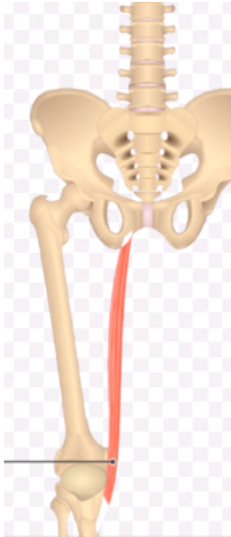
123. (1.00 pts) Buccinator

124. (1.00 pts)



125. (1.00 pts) Peroneus brevis

126. (1.00 pts)



127. (1.00 pts) Brachialis

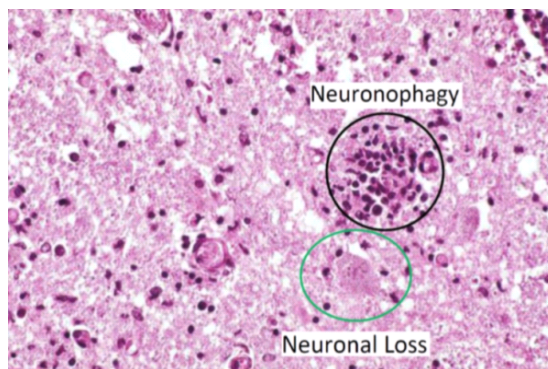
128. (1.00 pts)



129. (1.00 pts) Infraspinatus

130. (1.00 pts) Masseter

(SV) Histology: Answer the following questions based on the provided image. Point values are provided for each question. **Spelling counts! (14)**



131. (1.00 pts) Identify the disease present in the histological image. Provide the name stated in the **rules**. (1)

132. (1.00 pts) **True or False:** This disease is almost completely eradicated due to worldwide vaccinations. (1)

☐ True ☐ False

133. (2.00 pts) What is the **acronym** for the progressive syndrome of muscular weakness associated with this disease? (2)

134. (2.00 pts) What is the virus that causes this disease? (2)

135. (2.00 pts)

Which wild type virus was the primary cause of the majority of the world's cases of this disease until worldwide vaccination? (*Hint: Your answer must be a number*). (2)

136. (1.00 pts) **True or False:** Oral-oral spread with this disease is impossible. (1)

☐ True ☐ False

137. (2.00 pts) Choose the correct word to complete this sentence: (Shrunken, enlarged) motor neurons are characteristic but not pathognomonic of this disease. (2)

138. (1.00 pts) True or False: There are no approved antiviral medications for this disease. (1)

☐ True ☐ False

139. (1.00 pts) True or False: This disease is infectious and exclusively human disease. (1)

☐ True ☐ False

140. (1.00 pts) Would the spread of this virus be **rapid** or **slow** in areas with poor sanitation? (*Answer options: rapid or slow*). (1)

(KH) Short Answer: Answer the following questions in the most concise and specific way possible. Complete sentences are **not** required for this section. Point values will be designated for each question.

A rotator cuff is a group of muscles and their tendons that act to stabilize the shoulder and allow for its extensive range of motion. Of the seven scapulohumeral muscles, four make up the rotator cuff. Answer the following questions about the rotator cuff below. **(6)**

141. (2.00 pts) Identify the two muscles responsible for externally rotating the humerus. Provide your answers in **alphabetical order**. (2)

142. (1.00 pts) Identify the one muscle responsible for internally rotating the humerus. (1)

143. (1.00 pts) Identify the one muscle responsible for abducting the humerus. (1)

144. (1.00 pts) State the structure from which these muscles originate (1)

145. (1.00 pts) State the structure to which these muscles attach (1)

(SV) Pathology: Identify the diseases based on the provided descriptions. Be as specific as possible and use the names provided in the **rules** (**Example:** Do **not** input "MG. Input "myasthenia gravis.") Each question is worth **one** point. **(10)**

146. (1.00 pts) Some common names are Golfer's elbow and Swimmer's shoulder.

147. (1.00 pts) Symptoms include tenderness, mild swelling, dull aching pain.

148. (1.00 pts) Also called “the snowflake disease” since it affects each individual in a different manner.

149. (1.00 pts)

Acute treatment of this disease involves wound cleaning, antibiotic eradication, and IV metronidazole (500 mg, 3x daily) or penicillin (100,000 - 200,000 IU/kg/day).

150. (1.00 pts) Characterized by chronic musculoskeletal pain that is widespread; unknown etiology and uncertain pathophysiology.

151. (1.00 pts) Prematurity is a risk factor for this disease; includes periventricular leukomalacia and periventricular infarcts.

152. (1.00 pts) The initial symptom of a local version of this disease may be flaccid paralysis.

153. (1.00 pts) This disease causes hyperactivity of voluntary muscles (e.g. rigidity, spasms).

154. (1.00 pts) This disease is the most common cause of childhood disability, occurring in 1.5 to 2.5 deaths per 1000 deaths.

155. (1.00 pts) Some patients perceive harmful stimuli as being painful at lower levels of physical stimulation (in comparison to healthy individuals).

Thank you for taking our exam! We hope it provided a challenge despite the virtual format. Once again, feel free to email us with any questions, and good luck with your other events!

Best wishes,

Event Supervisors (Mahija and Sophia)