

# Anatomy and Physiology - Division C Exam

University of Georgia Science Olympiad Invitational 2019

**GEORGIA**



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**Team Number:** \_\_\_\_\_

**Team Name:** \_\_\_\_\_

**Total Points:** \_\_\_\_\_

**Rank:** \_\_\_\_\_

**Instructions and Clarifications:**

- You have **50** minutes to finish this exam.
- You **may** split the exam but you are responsible for placing the pages back in order. The page numbers are located in the lower right corner of each page for your convenience.
- Tiebreakers are labeled as **TB#**. There are **5** tiebreakers in this exam.
- Write your **team number** on every page of the answer sheet.
- Anything written on the exam will **not** be graded. Only the **answer sheet** will be graded.
- If you have any questions or comments about the exam, feel free to email me at [velasco.scienceolympiad@gmail.com](mailto:velasco.scienceolympiad@gmail.com). **Happy testing!**



## I. Integumentary System

**Multiple Choice Directions:** Choose the most appropriate answer for each question below. **No** partial credit will be awarded for multiple select questions. Each question is worth **one** point. **(20)**

1. Which of the following is a function of the integumentary system? (Multiple select)
  - a. Waterproof and protect deeper layers of the skin
  - b. Excretion of waste
  - c. Regulation of body temperature
  - d. Attachment site for sensory receptors
  
2. The integumentary system synthesizes which of the following vitamins?
  - a. A
  - b. B
  - c. K
  - d. D
  
3. Which of the following are the two main layers of the tissue? (Multiple select)
  - a. Epidermis
  - b. Dermis
  - c. Hypodermis
  - d. Subcutaneous layer
  
4. What cells form tight junctions with the nerves of the skin and hold the Langerhans cells and intradermal lymphocytes in position within the epidermis?
  - a. Melanocytes
  - b. Keratinocytes
  - c. Merkel cells
  - d. None of the above
  
5. What cells constitute 90% of the cells of the epidermis?
  - a. Keratinocytes
  - b. Melanocytes
  - c. Merkel cells
  - d. Langerhans cells



6. Which of the following stratum contain macrophages that arise in the bone marrow and then migrate to the stratified squamous epithelia of the epidermis, oral cavity, esophagus, and vagina? (Multiple select)
  - a. Stratum basale
  - b. Stratum spinosum
  - c. Stratum granulosum
  - d. Stratum lucidum
  
7. Which of the following stratum have cells that have no nuclei or other organelles?
  - a. Stratum basale
  - b. Stratum spinosum
  - c. Stratum granulosum
  - d. Stratum lucidum
  
8. Which of the following stratum have two to five layers of cells with dark-staining keratohyalin granules and is scanty in thin skin?
  - a. Stratum basale
  - b. Stratum spinosum
  - c. Stratum granulosum
  - d. Stratum lucidum
  
9. Which of the following layers of the skin is composed of mainly collagen but also contains elastic and reticular fibers, cells of fibrous connective tissue, blood vessels, sweat glands, sebaceous glands, hair follicles, and nail roots?
  - a. Epidermis
  - b. Dermis
  - c. Hypodermis
  - d. None of the above
  
10. Which of the following pigments below are concentrated in freckles and moles, on the dorsal surface of the hands and feet and in the nipple and areola?
  - a. Carotene
  - b. Hemoglobin
  - c. Melanin
  - d. None of the above



11. Which of the following statements below regarding abnormal colors of the skin is correct?
  - a. Jaundice is caused by high levels of urobilinogen in the blood, causing a yellowing of the skin and whites of the eyes.
  - b. Pallor could occur if there is little blood flow through the skin that the white color of the epidermal collagen shows.
  - c. A hematoma is a mass of clotted blood showing through the skin.
  - d. Erythema is caused by decreased blood flow in vasoconstricted blood vessels.
  
12. Which of the following functions of the skin is correct?
  - a. The skin allows the body from absorbing excess water during swimming or bathing.
  - b. The dermal surface of the skin is populated by bacteria.
  - c. The skin can resist and recover from trauma better than other organs of the body.
  - d. The skin is always impermeable to all chemicals, making it a strong support for the immune system.
  
13. Which of the following is a type of hair that is long, coarse and pigment and usually occurs on the scalp, eyebrows, and eyelashes?
  - a. Vellus
  - b. Terminal hair
  - c. Lanugo
  - d. None of the above
  
14. What layer of hair cross section is composed of a single layer of scaly cells that overlap each other with their free edges directed upwards?
  - a. Root
  - b. Medulla
  - c. Cortex
  - d. Cuticle
  
15. What is the layer of a follicle that is an extension of the epidermis?
  - a. Epithelial root sheath
  - b. Connective tissue root sheath
  - c. Piloerector muscle
  - d. None of the above



16. In what stage of hair growth do epithelial root sheath cells below the bulge undergo apoptosis?
- Anagen
  - Catagen
  - Telogen
  - None of the above
17. What part of a nail is composed of dead epidermis that covers the proximal end of the nail?
- Hyponychium
  - Nail groove
  - Eponychium
  - Lunule
18. What part of a nail is the region at the base of the nail that appears as a small white crescent due to a thick stratum basale that obscures dermal blood vessels from view?
- Free edge
  - Nail fold
  - Lunule
  - Nail groove
19. What gland in the skin is also considered a scent gland that respond to events of stress and sexual stimulation?
- Apocrine sweat glands
  - Merocrine sweat glands
  - Sebaceous glands
  - Mammary glands
20. What gland in the body matches the following description: *simple, coiled, tubular glands with ducts leading to the skin surface.*
- Sweat glands
  - Sebaceous glands
  - Ceruminous glands
  - Mammary glands



**Classification Directions:** Determine if the descriptions below pertain to thin or thick skin. Each question is worth **one** point. **(10)**

1. Does not have sebaceous glands
2. Does not have epidermal ridges
3. Has denser sensory receptors
4. Has numerous sudoriferous glands
5. Located everywhere on the body except for the palms, palmar surface of digits and soles
6. The epidermal thickness is 0.10-0.15 mm
7. Has the stratum lucidum
8. Does not have hair follicles
9. Does not have arrector pili muscles
10. Has dermal papillae that are parallel to each other

**Short Answer:** Answer the following questions below in the most concise and specific way possible. Each question is worth one point. **(10)**

1. What is the general term for a sensory receptor in the skin that responds to pressure or distortion?
2. What skin receptor responds to light touch?
3. What skin receptor responds to pressure?
4. What skin receptor detects tension in the deeper regions of the skin and fascia?
5. What skin receptor detects sustained pressure?
6. What is the general term for a sense receptor that detects changes in temperature?
7. What receptor responds to stimuli that are damaging?
8. From what type of stem cells do pain receptors develop from? **TB#1**
9. What type of pain receptor does not respond unless there is injury present?
10. What skin receptor can convert a chemical substance to a biological signal?

**Labeling Directions:** Label **Figure 1.1** and **1.2** in the image packet. Be as concise and specific as possible. Figure 1.2 is **TB#2**. Each letter is worth **one** point. **(17)**



**Image-based Questions:** Answer the following questions based on **Figure 1.3** in the image packet. Each question is worth **one** point unless otherwise stated. **(15)**

1. What is the structure labelled A?
2. What percent of the epidermis is composed of Structure A?
3. What is the primary function of Structure A?
4. List one protein in the skin that contributes to the skin's function as a barrier.
5. **True or False:** Structure A can produce CXCL10.
6. **True or False:** Structure A can produce CCL2.
7. **True or False:** Structure A can produce IL-10.
8. What effect would hydrocortisone have on the differentiation of Structure A? (2)
9. Cholecalciferol is another factor that can regulate the proliferation and differentiation of the Structure A. What is another name for cholecalciferol? (2)
10. Describe the nucleus and cytoplasm of the Structure A when exposed to UVA in presence of psoralens. (4)

**Pathology Directions:** Answer the corresponding questions based on Figures 1.4-1.7 in the image packet. Complete sentences are **not** required for this section. Each question is worth **one** point. **(8)**

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| <ol style="list-style-type: none"><li>1.<ol style="list-style-type: none"><li>a. What level of burn is shown in <b>Figure 1.4</b>?</li><li>b. What layers of the skin are affected by this burn?</li></ol></li><li>2.<ol style="list-style-type: none"><li>a. What disease is shown in <b>Figure 1.5</b>?</li><li>b. At what <b>two</b> ages/stages of life is this disease most common?</li></ol></li></ol> | <ol style="list-style-type: none"><li>3.<ol style="list-style-type: none"><li>a. What disease is shown in <b>Figure 1.6</b>?</li><li>b. List a region where this disease is common.</li></ol></li><li>4.<ol style="list-style-type: none"><li>a. What disease is shown <b>Figure 1.7</b>?</li><li>b. What would have caused the disease?</li></ol></li></ol> |
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## II. Skeletal System

**Multiple Choice Directions:** Choose the most appropriate answer for each question below. **No** partial credit will be awarded for multiple select questions. Each question is worth **one** point. **(20)**

1. What type of bone cell reside in lacunae which are connected by canaliculi?
  - a. Osteoblasts
  - b. Osteogenic cells
  - c. Osteoclasts
  - d. Osteocytes
  
2. Which of the following about the dry weight of the osseous tissue matrix is correct?
  - a.  $\frac{1}{3}$  organic and  $\frac{2}{3}$  inorganic matter
  - b.  $\frac{2}{3}$  organic and  $\frac{1}{3}$  inorganic matter
  - c.  $\frac{1}{2}$  organic and  $\frac{1}{2}$  inorganic matter
  - d.  $\frac{1}{4}$  organic and  $\frac{3}{4}$  inorganic matter
  
3. What type of bone tissue consists of trabeculae and is permeated by spaces filled with bone marrow?
  - a. Compact bone
  - b. Spongy bone
  - c. A and B
  - d. None of the above
  
4. What type of bone marrow consists of a delicate mesh of reticular tissue saturated with immature red blood cells and scattered adipocytes?
  - a. Myeloid tissue
  - b. Yellow bone marrow
  - c. Gelatinous bone marrow
  - d. None of the above
  
5. Which of the histological zones of transformation of cartilage bone involves walls between lacunae breaking down and chondrocytes dying?
  - a. Zone of reverse cartilage
  - b. Zone of cell proliferation
  - c. Zone of cell hypertrophy
  - d. Zone of bone deposition





6. What hormone promotes mineralization and lowers blood  $\text{Ca}^{2+}$  concentration in children?
  - a. Cortisol
  - b. Vitamin D
  - c. Calcitonin
  - d. Parathyroid hormone
  
7. What type of fracture involves bone being bent on one side and has an incomplete fracture on the opposite side?
  - a. Spiral
  - b. Epiphyseal
  - c. Greenstick
  - d. Nondisplaced
  
8. Which of the following statements below referring to cranial bones is correct?
  - a. There are 2 frontal bones.
  - b. There is 1 ethmoid bone.
  - c. There are 2 sphenoid bones.
  - d. There are 3 temporal bones.
  
9. Which of the following is considered a primary curvature? (Multiple select)
  - a. Cervical curvature
  - b. Thoracic curvature
  - c. Lumbar curvature
  - d. Pelvic curvature
  
10. What is the term for the triangular canal dorsal to the body of each vertebrae?
  - a. Vertebral canal
  - b. Vertebral arch
  - c. Pedicle
  - d. Vertebral foramen
  
11. An intervertebral disc consists of which of the following? (Multiple select)
  - a. Inferior vertebral notch
  - b. Superior vertebral notch
  - c. Nucleus pulposus
  - d. Annulus fibrosus



12. What type of vertebrae fits the following description: *thick, stout body, blunt, squarish spinous process*.
- Cervical
  - Thoracic
  - Lumbar
  - Sacrum
13. Which of the following is a region of the sternum? (Multiple select)
- Manubrium
  - Inferior articular facet
  - Body
  - Xiphoid process
14. How many bones are there per upper limb?
- 28
  - 30
  - 31
  - 32
15. Which of the following shows the correct order of the carpal bones of the proximal row starting at the lateral side?
- Pisiform, triquetrum, lunate, navicular
  - Pisiform, lunate, triquetrum, navicular
  - Navicular, triquetrum, lunate, pisiform
  - Navicular, lunate, triquetrum, pisiform
16. What is the term for the bones of the fingers?
- Metacarpals
  - Phalanges
  - Carpal bones
  - Coronoid processes
17. What is the ligament that extends from the acetabulum to a pit in the femur?
- Intertrochanteric crest
  - Linea aspera
  - Fovea capitis
  - Patellar surface



18. What is the largest tarsal bone?
- Talus
  - Calcaneus
  - Calcaneal tendon
  - Lateral cuneiform
19. What arch extends from the heel to hallux and is formed from the calcaneus, talus, navicular, cuneiforms and metatarsals I to III?
- Medial longitudinal arch
  - Lateral longitudinal arch
  - Transverse arch
  - None of the above
20. Which of the following is a ligament of the ankle? (Multiple select)
- Anterior tibiofibular ligaments
  - Posterior tibiofibular ligaments
  - Deltoid ligament
  - Lateral collateral ligament

**Labeling Directions:** Label **Figures 2.1-2.3** in the image packet. Figure 2.2 is **TB#3**. Be as concise and specific as possible. Each letter is worth **one** point. **(56)**

**Image-based Questions:** Answer the following questions based on **Figure 2.4** in the image packet. Each question is worth **one** point unless otherwise stated. **(16)**

- What is occurring in the given image? (2)
- What is the term for the layer that surrounds the cartilage, which eventually forms the periosteum? (2)
- Where do secondary centers typically appear in this process?
- Where does the first site of this process occur? (2)
- Where can chondrocytes undergoing rapid mitosis to form stacks be located? (2)
- What is formed during fracture healing?
- What continues to resorb bone until the ultimate thickness is achieved? (2)
- What is the term for the point of union between the primary and secondary center?
- What breaks down spongy bone to form the bone marrow cavity? (2)
- True or False:** This process does not occur during the rudimentary formation of long bones.



**Pathology Directions:** Answer the corresponding questions based on **Figures 2.5 and 2.6** in the image packet. Complete sentences are **not** required for this section. Each letter is worth **one** point unless otherwise stated. **(11)**

1.

- A. What disease/injury is shown in **Figure 2.5**?
- B. What grade of this disease/injury is shown in **Figure 2.5**?
- C. Where would this disease/injury be located in the body?
- D. What stress to a slightly bent knee can be the cause of this disease/injury?
- E. List a possible treatment for this disease.

2.

- A. What disease is shown in the MRI in **Figure 2.6**?
- B. List **two** symptoms of this disease. (2)
- C. True or False: Men are more likely to develop this disease.
- D. True or False: Hemochromatosis can contribute to this disease.
- E. True or False: Obesity does not contribute to this disease.



### III. Muscular System

**Multiple Choice Directions:** Choose the most appropriate answer for each question below. **No** partial credit will be awarded for multiple select questions. Each question is worth **one** point. **(10)**

1. What is the connective tissue sheath that separates each fascicle from each other?
  - a. Endomysium
  - b. Perimysium
  - c. Epimysium
  - d. Superficial fascia
  
2. The intercostal muscles between the ribs show what type of muscle attachment?
  - a. Direct attachment
  - b. Indirect attachment
  - c. A and B
  - d. None of the above
  
3. What type of muscle is fan-shaped, broad at the origin, and moves toward a narrower insertion?
  - a. Fusiform
  - b. Parallel
  - c. Pennate
  - d. Convergent
  
4. What type of muscles have fascicles that insert obliquely on a tendon that runs the length of the muscle?
  - a. Convergent
  - b. Parallel
  - c. Pennate
  - d. Fusiform
  
5. What is the term for a muscle that aids the muscle that produces the most of the force during a particular joint action?
  - a. Synergist
  - b. Prime mover
  - c. Antagonist
  - d. Fixator



6. What type of skeletal muscle that fits the following description: *voluntary striated muscle that is usually attached to one or more bones.*
  - a. Cardiac
  - b. Smooth
  - c. Skeletal
  - d. None of the above
  
7. Skeletal muscles are innervated by what type of motor neurons?
  - a. Automatic
  - b. Somatic
  - c. Enteric
  - d. None of the above
  
8. Each branch of a motor nerve fiber ends in a bulbous swelling called what?
  - a. Synaptic cleft
  - b. Synaptic knob
  - c. Motor end plate
  - d. Synaptic vesicles
  
9. What is the term for the functional connection between the distal end of a nerve fiber and the middle of a muscle fiber?
  - a. Motor end plate
  - b. Synaptic cleft
  - c. Synaptic knob
  - d. Neuromuscular junction
  
10. Which of the following statements about muscle excitation is correct? (Multiple select)
  - a. Sodium ions stimulate exocytosis of synaptic vesicles, which releases ACh into the synaptic cleft.
  - b. The receptors of ACh are voltage-gated ion channels.
  - c. The areas of sarcolemma next to the end plate have voltage-gated ion channels that open in response to EPP.
  - d. The voltage of the sarcolemma reverses polarity as a result of ion movements.



**True or False:** Determine if the statements below are true or false. Each question is worth **one** point. **(10)**

1. Cardiac muscles do not contain sarcomeres.
2. There are three major subtypes of Type II, fast twitch muscles.
3. The epimysium anchors muscle tissue to tendons.
4. Pennate muscles have fibers that are oriented at an angle relative to the line of action.
5. The volume of a muscle determines how forcefully it contracts.
6. The afferent leg of the peripheral nervous system sends signals to the muscles.
7. Not all muscles in the body produce adenosine triphosphate.
8. Pyruvate is formed in aerobic conditions in the process of glycolysis.
9. Muscle hypertrophy can occur due to exercising.
10. Acetyl and choline cannot activate the ACh receptor.

**Diagram-based Part 1 questions:** Based on **Figure 3.1** in the image packet, determine if the statement describes muscle type A, B or C. Write **A, B or C** for your answers. Each question is worth **one** point. **(10)**

1. Located in the heart
2. Also called the myocardium
3. Located in the intestines
4. Not under conscious control
5. Connected to bones
6. Contains myofibrils that are not arranged in sarcomeres
7. Divided into slow twitch and fast twitch types
8. Also known as myocytes
9. Has a fusiform shape
10. Connected to each other through intercalated discs



**Origin, Insertion, and Function Directions:** Complete the table below regarding the origin, insertion and function of the muscles listed. Each letter is worth **two** points. **TB#4 (20)**

<b>Muscle Name</b>	<b>Origin</b>	<b>Insertion</b>	<b>Function</b>
<b>A.</b>	Acromial extremity of clavicle (anterior fibers), acromion of scapula (lateral fibers), and spine of scapula (posterior fibers)	<b>B.</b>	Abduct arm at the shoulder joint, flex and medially rotate the arm at the shoulder joint, extend and laterally rotate arm at shoulder joint
<b>C.</b>	<b>D.</b>	Vertebral border and inferior angle of scapula	Abducts scapula and rotates it upward, elevates ribs when scapula is stabilized, punching and pushing (horizontal arm movements)
Brachialis	Distal, anterior surface of the humerus	<b>E.</b>	<b>F.</b>
<b>G.</b>	Ilium	Tibia by iliotibial tract	<b>H.</b>
<b>I.</b>	Long head arises from the ischial tuberosity; short head arises from the linea aspera of femur	<b>J.</b>	Flexes the leg at the knee joint and extends thigh at hip joint

**Labeling Directions:** Label **Figures 3.2 and 3.3** in the image packet. Be as concise and specific as possible. Each letter is worth **one** point. **(30)**

**Diagram-based Part 2 Questions:** For each **LETTER**, write a sentence about what is occurring in **Figure 3.4** in the image packet. For each **NUMBER in Figure 3.4** in the image packet, label the structure denoted. Each **number and each letter** are worth **two** points. Partial credit will be given. **(36)**





**Pathology Directions:** Answer the corresponding questions based on **Figures 3.5 and 3.6**. **Figure 3.5** is **TB#5**. Complete sentences are **not** required for this section. Each letter is worth **one** point unless otherwise stated. **(11)**

1.

- A. What disease is shown above?
- B. What is an alternative name of this disease?
- C. What is the genus of the pathogen that causes this disease?
- D. What percent of patients will develop life-altering disability due to this disease?
- E. How many types of this disease can occur after infection of the disease-causing pathogen?

2.

- A. What is the disease that causes the symptom shown above?
- B. List two symptoms associated with this disease. (2)
- C. How many people are affected by this disease per million people?
- D. In what percentage of individuals have the symptom shown in the image above?
- E. **True or False:** The prognosis of this disease is generally bad.