2020 Golden Gate Science Olympiad Invitational Anatomy and Physiology Exam

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Time limit: 50 minutes

Instructions and Clarifications:

- Each **team** may bring **one** 8.5” x 11” sheet of paper, which may be in a sheet protector sealed by tape or laminated, that may contain information on both sides in any form and from any source without any annotations or labels affixed along with **two** stand-alone non-programmable, non-graphing calculators.
- Anything written on the exam will **not** be graded. Only the **answer sheet** will be graded.
- Write your **team number** on every page of the answer sheet.
- There are **five** tiebreakers in this exam. They are denoted as **TB#**.
- If you have any questions or comments about this exam, contact me at ***velasco.scienceolympiad@gmail.com.*** **Happy testing!**

Names:_____

Team Number:_____

School:_____

Score: /343

Rank:

I. Integumentary System

Multiple Choice: Choose the most appropriate answer option for each question below. Each question is worth **one** point. **(20)**

1. What part of the skin is composed of keratinized, stratified squamous epithelium and is avascular?
    a. Epidermis
    b. Dermis
    c. Subcutaneous layer
    d. A and B
    e. None of the above

2. What stratum is only found in thick skin?
    a. Spinosum
    b. Basale
    c. Granulosum
    d. Corneum
    e. Lucidum

3. What stratum contains granules that fuse with the plasma membrane and then release a lipid-rich secretion?
    a. Lucidum
    b. Basale
    c. Granulosum
    d. Corneum
    e. None of the above

4. Carotene in the skin is stored in fatty areas and in what stratum?
    a. Spinosum
    b. Basale
    c. Granulosum
    d. Corneum
    e. Lucidum

5. What cell in the epidermis can participate in immune responses against pathogens that invade the skin?
    a. Merkel cells
    b. Langerhans cells
    c. Keratinocytes
    d. Mast cells
    e. Melanocytes

6. Which of the following statements correctly describes the reticular layer? **TB#1**
    a. Made of loose, areolar connective tissue
    b. Contains fibroblasts, adipocytes, and an abundance of small blood vessels
    c. Contains lymphatic capillaries, nerve fibers, and Meissner corpuscles
    d. Made of dense, irregular connective tissue
    e. Projects into the stratum basale to form the dermal papillae

7. How many days after the initial sun exposure is required for melanin synthesis to peak?
    a. 5
    b. 7
    c. 10
    d. 30
    e. 42

8. What part of the hair is a downward continuation of the epidermis?
    a. External root sheath
    b. Internal root sheath
    c. Dermal root sheath
    d. Papilla
    e. Hair matrix

9. What type of hair cover most of the body in childhood?
    a. Lanugo
    b. Terminal
    c. Vellus
    d. A and B
    e. B and C

10. What type of skin gland primarily functions to prevent hairs from drying out and to prevent water loss from the skin?
    a. Eccrine sweat gland
    b. Apocrine sweat gland
    c. Ceruminous gland
    d. Mammary gland
    e. Sebaceous gland

11. What percent of the total blood flow in an adult is found in the dermis?
    a. 8-10%
    b. 13-15%
    c. 20-30%
    d. 50%
    e. None of the above. The dermis is avascular.

12. Which of the vitamins is not absorbed by the skin?
    a. A
    b. B
    c. D
    d. K
    e. E

13. Calcitriol, which is produced with the help of the skin, is the most active form of which vitamin?
    a. A
    b. B
    c. D
    d. K
    e. E

14. What level of burn extends into the underlying fat, muscle, and bone?
    a. Superficial
    b. Superficial partial thickness
    c. Deep partial thickness
    d. Full thickness
    e. Fourth-degree

15. What level of burn is considered to be the most painful?
    a. Superficial
    b. Superficial partial thickness
    c. Deep partial thickness
    d. Full thickness
    e. Fourth-degree

16. What type of skin cancer carries a UV-signature mutation that indicates they are caused by UVB radiation via direct DNA damage?
    a. BCC
    b. SCC
    c. Melanoma
    d. A and B
    e. A, B and C

17. The species of which of the following genus can cause tinea pedis?
    a. *Epidermophyton*
    b. *Microsporum*
    c. *Trichophyton*
    d. A and B
    e. A, B, and C

18. Which of the following pathogen(s) is the most common cause of impetigo contagiosa?
    a. *Clostridium tetani*
    b. *Staphylococcus aureus*
    c. *Streptococcus pyogenes*
    d. A and B
    e. B and C
    f. A, B, and C
    g. None of the above

19. Which of the following statements below correctly describes boils?
    a. Boils can be as large as golf balls.
    b. Boils are not filled with pus.
    c. A person who is diabetic has a lower chance of having boils.
    d. The lymph nodes are not inflamed even when an individual has multiple boils.
    e. Boils are not painful.

20. Which of the following could be a symptom of metal allergy?
    a. Itching
    b. Redness
    c. Dry patches
    d. Rash
    e. Swelling
    f. Leathery skin
    g. Skin filled with pus
    h. A, C, E, G
    i. B, D, E, F
    j. A, B, C, F, G
    k. A, B, C, D, E, F, G

True or False: Determine if the statements below are True or False. If the statement is **True**, write **"T"** as your answer and **"F"** if the answer is **False**. Each question is worth **one** point. **(10)**

1. Tyrosinase regulates the mechanism behind human skin color.
2. Pheomelanin is the most common form of biological melanin.
3. Most eumelanin is derived from the amino acid proline.
4. MC1R is the gene that is mostly responsible for determining which type of biological melanin is produced in the human body. **TB#2**
5. Sunlight is the main cause of skin aging.
6. Thick skin contains an abundance of sebaceous glands.
7. There are denser sensory receptors in thick skin than thin skin.
8. Thin skin contains dermal papillae that are irregular.
9. The Malpighian layer of thick skin is thinner relative to the Malpighian layer of thin skin.
10. There is thick skin found on the soles of the feet.

Diagram-based Questions: Use Figures **1.1-1.4** in the **image packet** for this section. **Identify** the mechanoreceptors based on the given images. Then, determine what **information** each mechanoreceptor detects. Lastly, determine the **rate of adaptation** for each mechanoreceptor. Each image is worth **three** points. **(12)**

Labeling: Use Figures **1.5-1.6** in the image packet for this section. Label the figures provided. Be as specific as possible. Each letter is worth **one** point. **(14)**

Short Answer: Read and answer the questions below in the most concise way possible. The point values for each question are found within the parentheses. Complete sentences are **not** required for this section. **(21)**

1. While waiting for your other events during the GGSO Invite, you decided to stare at your nails and noticed that some of the proximal and distal ends of your nail body are white. What are these parts of the nail body? Explain why they are white. (5)

2. The day after the Golden Gate Invitational, your Science Olympiad team decided to tan at Santa Monica Beach! On your way to Santa Monica Beach, you decided to watch an episode of House and one patient was severely burned. As the doctors and nurses were preparing the patient, you heard House say “Quickly estimate the burn surface area of the patient. It’ll give us a good idea of what we’re dealing with.” Using your pathology knowledge, what is the **name** of the **rule** that can give a quick estimate of a burn surface area? **Explain** the **parts** of rule thoroughly (*Hint: percentages are required for full credit*). (11)

3. After several hours of being under the sun, your teammates were happy with their tanned look. However, after two weeks, your teammates’ skin color is back to normal. Why was the tan from your Santa Monica Beach trip impermanent? (5)

Pathology: Use Figures **1.7-1.16** in the image packet for this section. Determine what disease is shown in the images provided. Be as specific as possible (e.g. if a burn is shown, determine the degree of the burn for **full** credit). Each question is worth **one** point. **(10)**

II. Skeletal System

Multiple Choice: Choose the most appropriate answer option for each question below. Each question is worth **one** point. **(20)**

1. What part of a long bone is composed of an outer fibrous layer of dense irregular connective tissue and an inner osteogenic layer composed of cells?
    a. Metaphyses
    b. Periosteum
    c. Perforating fibers
    d. Articular cartilage

2. What part of a long bone contains one layer of bone-forming cells and some connective tissue?
    a. Periosteum
    b. Endosteum
    c. Diaphysis
    d. Epiphyses

3. What cells secrete collagen fibers and initiate calcification in a growing bone?
    a. Osteoprogenitor cells
    b. Osteoblasts
    c. Osteocytes
    d. Osteoclasts

4. Which of the following statements about osteon is correct?
    a. Cement line is the boundary of an osteon.
    b. Osteons do not have lamellae.
    c. Some osteocytes develop into osteoblasts that reside in the lacuna.
    d. Collagen fibers in some lamellae run perpendicular to each other.

5. Which of the following statements about spongy bone tissue is correct?
    a. It is sometimes located outside a bone.
    b. The lacunae are arranged in a regular pattern.
    c. This type of tissue is usually located where bones are not heavily stressed.
    d. Spongy bone tissue is heavier than compact bone tissue.

6. Which of the following occurs in intramembranous ossification?
    a. In the development of an ossification center, osteoblasts differentiate into osteoprogenitor cells.
    b. Osteocytes extend their cytoplasmic processes into canaliculi.
    c. As the bone extracellular matrix forms, it develops into trabeculae that fuse to eventually form compact bone tissue around the network of blood vessels in the tissue.
    d. During the development of the periosteum, a thin layer of spongy bone tissue replaces the surface layers of compact bone tissue.

7. Which of the following occurs in the development of the primary ossification center in endochondral ossification?
    a. This process spreads from the outside towards the center of the developing bone.
    b. There is a differentiation of osteoblasts into osteoprogenitor cells.
    c. The primary ossification center develops, which is a region where cartilage replaces bone tissue.
    d. Primary ossification proceeds inward from the external surface of the bone.

8. What zone of an epiphyseal plate is composed of large maturing chondrocytes arranged in columns?
    a. Zone of resting cartilage
    b. Zone of calcified cartilage
    c. Zone of proliferating cartilage
    d. Zone of hypertrophic cartilage

9. Which of the following statements about bone growth in thickness is correct?
    a. When an osteon is forming, osteoblasts under the periosteum deposit new circumferential lamellae.
    b. Osteocytes develop into osteoblasts when they are surrounded by extracellular matrix.
    c. Osteocytes in the endosteum deposit bone extracellular matrix, leading to the formation of new concentric lamellae.
    d. None of the above

10. What phase of fracture repair has a conversion of fibrocartilage to spongy bone?
    a. Reactive phase
    b. Bone remodeling phase
    c. Fibrocartilaginous callus formation
    d. Bony callus formation

11. Which vitamin is needed for the activity of osteoblasts during bone remodeling, considered toxic in high doses and can stunt bone growth with a deficiency of this vitamin?
    a. D
    b. C
    c. A
    d. K

12. Which hormone is secreted by the anterior lobe of the pituitary gland and promotes the general growth of all body tissues, mainly by stimulating the production of insulin-like growth factors (IGFs)?
    a. PTH
    b. CT
    c. hGH
    d. A and B
    e. None of the above

13. What mineral contributes to the **formation** of the bone extracellular matrix? *(Hint: Not the mineral that makes the extracellular matrix **hard**.)*
    a. Phosphorus
    b. Calcium
    c. Manganese
    d. Magnesium

14. What type of movement at a synovial joint involves a movement of trunk in frontal plane?
    a. Lateral flexion
    b. Extension
    c. Hyperextension
    d. Gliding

15. What type of movement at a synovial joint involves a movement of the forearm that turns the palm anteriorly?
    a. Dorsiflexion
    b. Supination
    c. Pronation
    d. Opposition

16. What type of fibrous joint articulates bones through a sheet of dense irregular connective tissue?
    a. Synchondrosis
    b. Syndesmosis
    c. Suture
    d. Interosseous membrane

17. What type of synovial joint has a convex surface that fits into a concave surface?
    a. Pivot
    b. Saddle
    c. Hinge
    d. Plane

18. Which of the following statements about circumduction is correct?
    a. It is a movement of the proximal end of a body part in a circle.
    b. It is the combination of flexion, extension, adduction, and abduction.
    c. Circumduction does not occur in the fingers.
    d. Circumduction is more limited in the shoulder joints than hip joints.

19. Which of the following activities would require flexion?
    a. Looking up at the sun
    b. Backbending
    c. Shooting a basketball
    d. Swinging the arms forward while walking

20. Which of the following activities would require hyperextension?
    a. Crunches
    b. Bending the elbow
    c. Bending the head backward to look at the stars
    d. Wrist curls

Classification: Based on the details below, determine what vertebrae type is described. Each question is worth **one** point. **(10)**

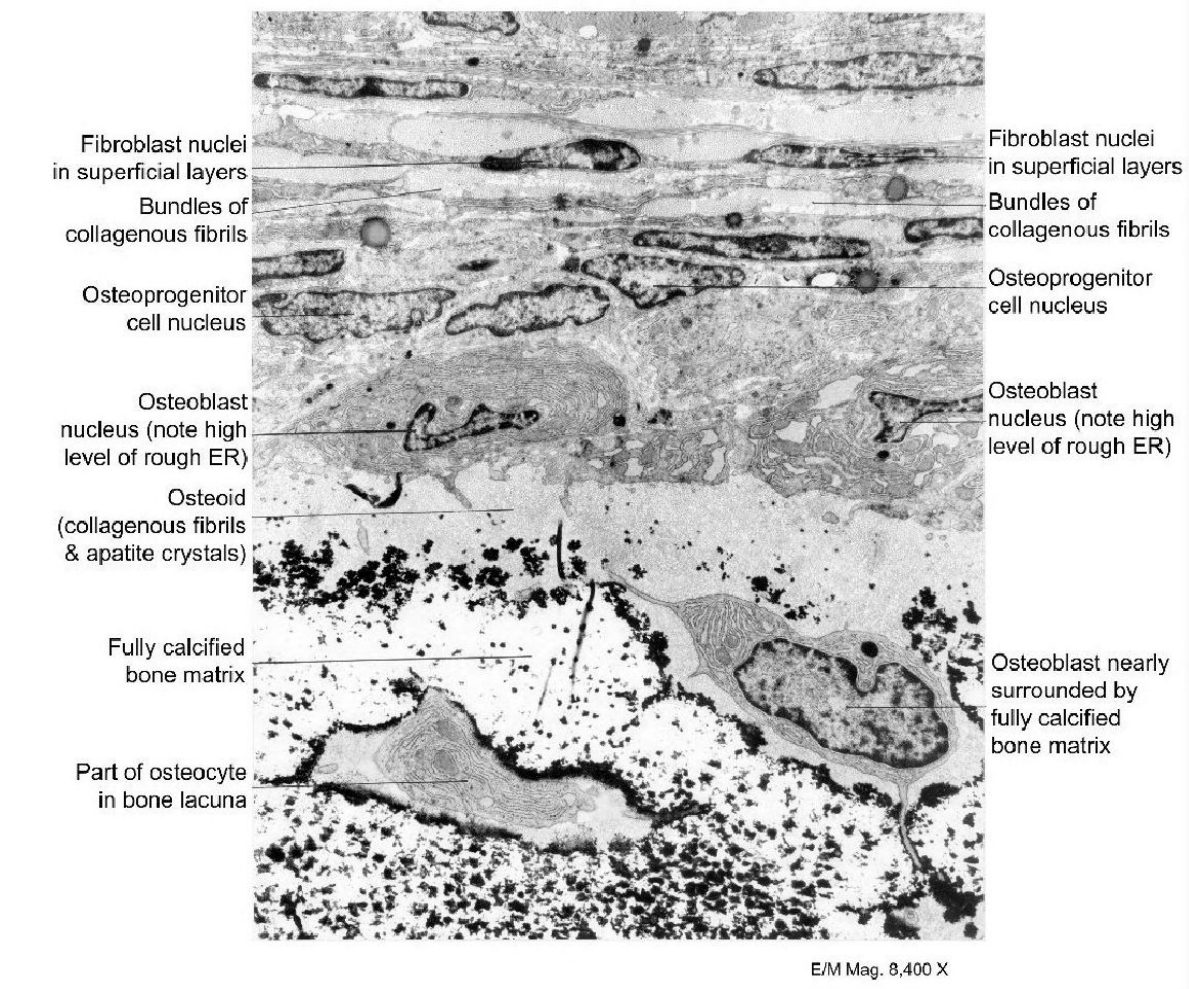
1. This vertebral type articulates with the ribs.
2. This type has one vertebral foramen and two transverse foramina.
3. Most of the spinous processes of this type project inferiorly.
4. The thick and broad spinous processes project nearly straight posteriorly.
5. This type is the largest type of vertebrae.
6. The superior articular processes are directed medially.
7. The spinous processes have a quadrilateral shape.
8. The first vertebra of this type lacks a body and a spinous process.
9. The name of the first vertebrae of this type is the atlas.
10. A vertebral body of this type is a ring of bone with anterior and posterior arches and large lateral masses. *(Hint: Named after a mythological character who supported the world on his shoulders.)*

Identification: Identify what structure is described based on the details below. Then, **determine** if this structure is part of the axial or appendicular skeleton. On your answer sheet, you **may** write AX for axial and AP for appendicular. Each question is worth **two** points. **(10) TB#3**

1. This structure is an important landmark for the sternum, and this structure can break if improper CPR is performed.
2. The proximal end of this bone forms a semilunar notch that fits over the end of the humerus.
3. This is considered to be the fourth fossa of the scapula and is where the head of the humerus connects to the scapula.
4. This is known to be the central axis of the skeleton and consists of 26 bones.
5. This part of the body contains seven tarsal bones.

Labeling: Use Figures **2.1-2.2** in the image packet for this section. Label the diagrams provided. Be as specific as possible. Each letter is worth **one** point. **(36)** *(Hints: 1. Some answers are repeats. 2. Structure P in Figure 2.2 is a multi-bone structure.)*

Image-based Questions: Answer the following questions based on the image given. Each question is worth **one** point unless stated otherwise. **(12) TB#4**



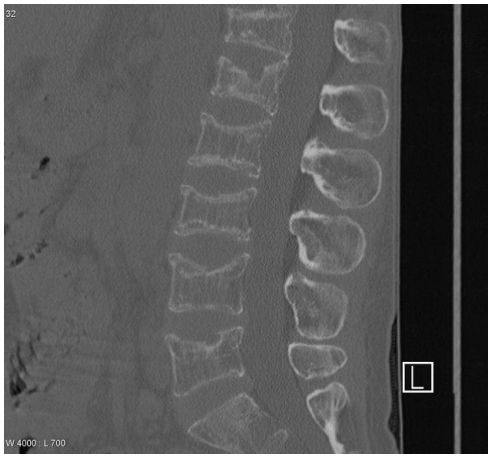
1. Which ossification process is shown in the image?
2. In this process, a mesenchymal stem cell (MSC) can develop into what type of bone cell? (2)
3. What is the name of the small, dense cluster of MSCs that forms at the beginning of this process? (2)
4. Later on, osteoblasts create an extracellular matrix containing what type of fibrils?
5. Some osteoblasts within an osteoid can turn into what type of cells? (2)
6. What forms in the first step of this process that eventually fuse together to become trabeculae?
7. Is the area where bone growth occurs between the periosteum and the bone the primary or secondary center of ossification?
8. Osteons form in this ossification process. Osteons are the main components of what type of bone? (2)

Pathology: Based on the given X-rays and MRIs, determine what disease is shown. Each image is worth **three** points. **(18)**

1.

2.

3.



4.

5.

6.

III. Muscular System and Joints

Multiple Choice: Choose the most appropriate answer option for each question below. There is **no** partial credit for the multiple select question. Each question is worth **one** point. **(20)**

1. What layer of connective tissue surrounds the entire muscle?
    a. Endomysium
    b. Epimysium
    c. Perimysium
    d. Fascia

2. What part of a sarcomere is the region in the H zone that contains proteins that hold the thick filaments together at the sarcomere's center?
    a. A band
    b. I band
    c. Z disc
    d. M line

3. Which of the following are contractile proteins?
    a. Myosin and actin
    b. Myosin and tropomyosin
    c. Actin and troponin
    d. Troponin and tropomyosin

4. Which level of organization within a skeletal muscle describes a bundle of muscle fibers wrapped in perimysium?
    a. Fascicle
    b. Muscle fiber
    c. Myofibril
    d. None of the above

5. Which level of organization within a skeletal muscle describes threadlike contractile elements within the sarcoplasm of a muscle cell that extends the entire length of the cell and is composed of filaments?
    a. Fascicle
    b. Muscle fiber
    c. Myofibril
    d. None of the above

6. Which of the following is a correct step in the contraction cycle?
    a. Myosin heads hydrolyze ADP.
    b. Myosin heads bind to tropomyosin, forming cross-bridges.
    c. Myosin cross-bridges rotate toward the sarcomere's center.
    d. During a power stroke, the site on the cross-bridge where ATP is still bound opens.

7. What neurotransmitter is released at the neuromuscular junction (NMJ)?
    a. GABA
    b. ACh
    c. Dopamine
    d. Serotonin

8. Which of the following statements anaerobic glycolysis is correct?
    a. Compared to aerobic respiration, anaerobic glycolysis produces more ATPs but is slower.
    b. This process does not require oxygen, so it cannot occur when oxygen is present.
    c. Pyruvic acid is converted into lactic acid in this process.
    d. One glucose molecule catabolized via this process yields 4 molecules of lactic acid and 4 molecules of ATP.

9. Which of the following occurs after exercise?
    a. There is an increase in breathing rate and blood flow in prolonged periods of muscle contraction.
    b. Pyruvic acid is converted back into glycogen when there is extra oxygen present.
    c. Metabolic changes during exercise account for a large portion of extra oxygen used after exercise.
    d. Increased temperature in the body after exercise decreases the rate of chemical reactions in the body.

10. A motor unit is composed of what?
    a. Autonomic motor neuron plus some of the skeletal muscle fibers it stimulates
    b. Autonomic motor neuron plus all of the skeletal muscle fibers it stimulates
    c. Somatic motor neuron plus some of the skeletal muscle fibers it stimulates
    d. Somatic motor neuron plus all of the skeletal muscle fibers it stimulates

11. Which of the following statements about muscle tone is correct?
    a. The muscle can only become flaccid if the motor neurons stimulating that skeletal muscle is cut.
    b. Muscle tone is not strong enough to cause movement.
    c. Muscle tone does not contribute to smooth muscle tissue movements.
    d. Muscle tone is only established by the brain.

12. Which of the following statements about smooth muscle tissue is correct?
    a. A decrease in Ca^{2+} cytosol concentration initiates contraction.
    b. There is a smaller amount of SR in smooth muscle than skeletal muscle.
    c. Ca^{2+} only flows into the smooth muscle cytosol from the SR.
    d. There are some T tubules in smooth muscle fibers.

13. What is the term for a rigid structure that moves around a fixed point?
    a. Load
    b. Resistance
    c. Fulcrum
    d. Lever

14. What arrangement of fascicles is spread over a broad area that converges at a thick central tendon?
    a. Parallel
    b. Fusiform
    c. Triangular
    d. Circular

15. Which of the following molecules do the **work** of shortening the muscle fiber? (*Multiple select*)
    a. Tropomyosin
    b. Myosin
    c. Troponin
    d. Actin

16. What ion is released into the sarcoplasm to activate contraction?
    a. Magnesium
    b. Calcium
    c. Sodium
    d. Potassium

17. Which of the following types of myofibrils is a fibrous protein made of a long chain of a specific actin molecule twisted into a helix?
    a. F
    b. G
    c. A
    d. H

18. What is a term for the smooth ER of a muscle fiber?
    a. Sarcolemma
    b. Sarcoplasm
    c. Sarcoplasmic reticulum
    d. Sarcomere

19. What is the neurotransmitter released by a somatic motor fiber that stimulates a skeletal muscle fiber?
    a. ACh
    b. GABA
    c. Serotonin
    d. Dopamine

20. What is the term for a muscle that stabilizes the origin of a prime mover?
    a. Agonist
    b. Antagonist
    c. Fixator
    d. Synergist

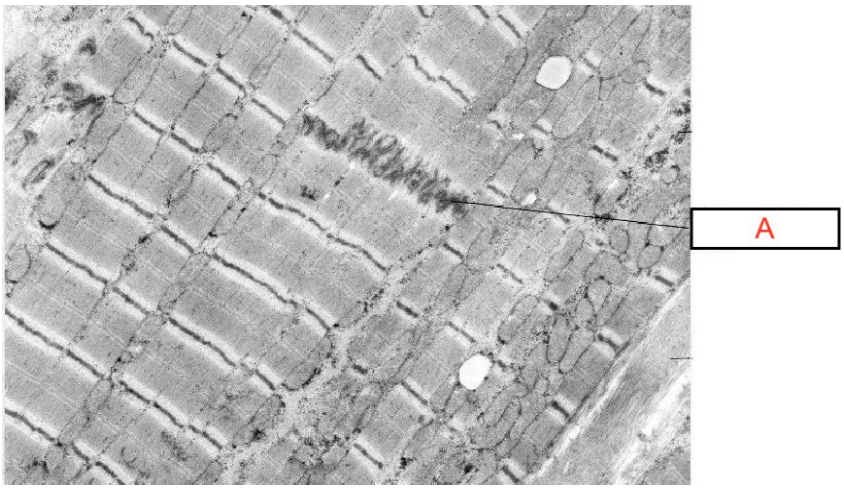
Identification: Based on the descriptions below, determine what type of joint is being described. Be as specific and concise as possible. Each question is worth **two** points. **(10)**

1. Articulating bones are united by a dense, irregular connective tissue (usually articulated by a ligament)
2. The connecting material is a broad, flat disc of fibrocartilage
3. This type of cartilaginous joint is immovable
4. This joint type is an oval-shaped projection that fits into an oval-shaped depression
5. The bones are articulated by a thin layer of dense irregular connective tissue and can be found between skull bones

Origin, Insertion, Function: Complete the table below regarding the origin, insertion, and function of the specified muscles. Each letter is worth **two** points. **(16)**

Muscle	**Origin**	**Insertion**	**Action**
A,	Maxilla and zygomatic arch	**B.**	Elevates the mandible
C.	**D.**	Greater tubercle and lateral lip of intertubercular sulcus of humerus	Adducts and medially rotates the arm at the shoulder joint; clavicular head flexes the arm, and sternocostal head extends flexed arm to side of trunk
Brachioradialis	**E.**	**F.**	Flexes the forearm at the elbow joint; supinates and pronates forearm at the radioulnar joints to the neutral position
G.	Medial epicondyle of humerus	Metacarpals II and III	**H.**

Image-based Questions: Answer the following questions based on the image given. Each question is worth **one** point unless stated otherwise. **(12)**



1. What type of muscle is shown in the given image?
2. What is the name of the structure labeled A? (2)
3. What cells produce the extracellular matrix?
4. What is the name of the microscopic tubules that run from the cell surface to deep within the cell?
5. List one type of syncytium connected by the connection fibers of this muscle type. (2)
6. **True or False:** This muscle type is voluntary.
7. **True or False:** The lighter bands seen in the image is called A bands.
8. **True or False:** The electrical resistance through Structure A is very low.
9. **True or False:** Each syncytium obeys the all or none law.
10. **True or False:** Structure A is present in all types of muscles.

Identification: Read and answer the following questions below in the most concise and specific way as possible. Complete sentences are **not** required for this section. Each question is worth **one** point. **(10)**

1. What protein connects the Z disc to the M line?
2. What protein assists in the anchoring of thin filaments to Z discs and regulates the length of thin filaments during development?
3. What protein binds to titin molecules and connects adjacent thick filaments to each other?
4. What protein has a myosin-binding site that myosin binds to during muscle contraction?
5. What protein are thick filaments mainly composed of?
6. What protein changes shape when calcium ions bind to it, making another protein move away from the myosin-binding sites on actin molecules?
7. What protein links thin filaments to integral membrane proteins in the sarcolemma?
8. What protein attaches to titin molecules and actin molecules of thin filaments? **TB#5**
9. What protein covers the myosin-binding sites on actin molecules?
10. What protein is believed to transmit tension generated by sarcomeres to tendons?

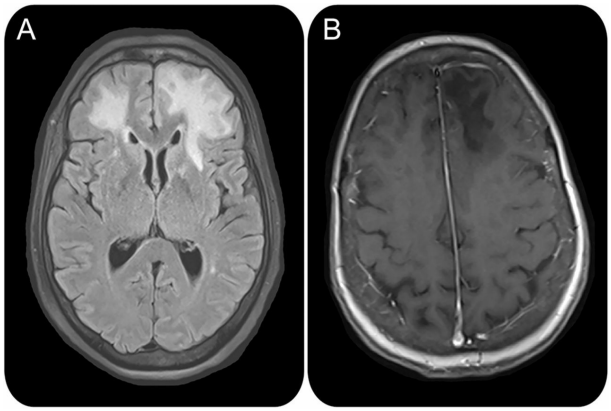
Labeling: Use Figures **3.1-3.2** in the image packet for this section. Label the diagrams provided. Be as specific as possible. Answers for **Figure 3.2** that are incorrectly spelled will **not** receive partial credit. Each letter is worth **one** point. **(33)** *(Hint: One repeat for Figure 3.2.)*

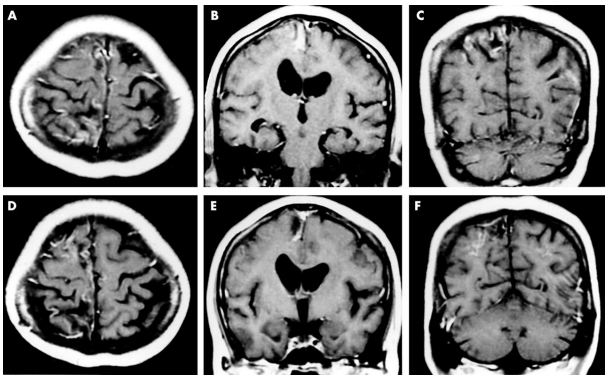
Pathology: Determine what disease is shown on the given MRI or X-ray. Each image is worth **three** points. **No** partial credit will be awarded for this section. **(18)**

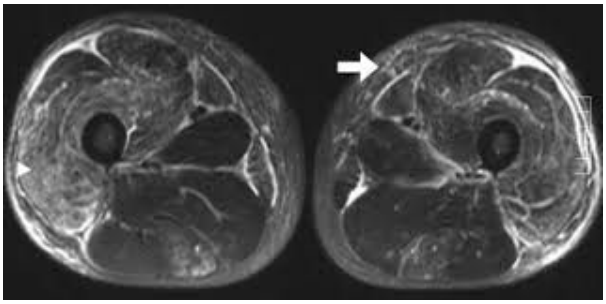
1. 

2. 

3. 

4. 

5. 

6. 

IV. Case Study*

After coming back from the Santa Monica Beach trip, you decided to grab groceries before heading home. You came across a friendly woman as you looked for ramen noodles and chicken nuggets (your essential groceries). She made a comment about your Science Olympiad hoodie that you were wearing and introduced herself as Talia. You noticed that she was having trouble with her groceries, so you decided to help.

“Thank you for helping. I’ve been experiencing double vision, so it’s hard for me to see,” she said, looking tired, but not with pallor.

Getting a closer look at her face, you saw that she has bilateral ptosis, and she seems to have limited eye movement as she looks from left to right while she walks down the grocery alley.

Using your anatomy and physiology knowledge, you decided to ask her to perform a weird task: “Could you do 10 squats in a row for me?”

Laughing as she does so, she managed to perform 6 squats but then needed to use her hands to stand up afterward. “Huh, that’s weird,” Talia noted.

After exchanging numbers, you told her calmly that she should go to a doctor for an examination. Despite looking skeptical, she promised you that she would do so.

Two weeks later, she sent you a text, confirming your correct diagnosis, along with several EMGS, a chest X-ray, and a table of examination value normal limits. **(Appendix)**

Based on this case study and the diagrams in the appendix, answer the following questions. **(31)**

1. Talia’s condition is caused by what disease? (3)
2. If Talia was pregnant, is there an increased or decreased risk of a crisis? (2)
3. List one symptom from your grocery store interaction with Talia that supports your diagnosis. (2)
4. Support your diagnosis by analyzing Talia’s EMGs **(Figure 1)**. (6)
5. As seen in **Figure 2**, Talia’s X-ray shows a thymoma. What surgery will Talia undergo as a result of this thymoma? (2)
6. **True or False:** Some authors may tell Talia to undergo the procedure in question 6 even if she does not have a thymoma since she is less than 40 years old. (2)
7. Explain the root cause of Talia’s muscle weakness. Support your answer by analyzing Talia’s examination values **(Figure 3)**. (8)
8. What is the symptomatic treatment for this disease? (2)
9. What is the first nonsteroidal immunosuppressive treatment (IS) recommended for this disease? (2)
10. State an example of a second-line treatment for this disease. (2)

Appendix

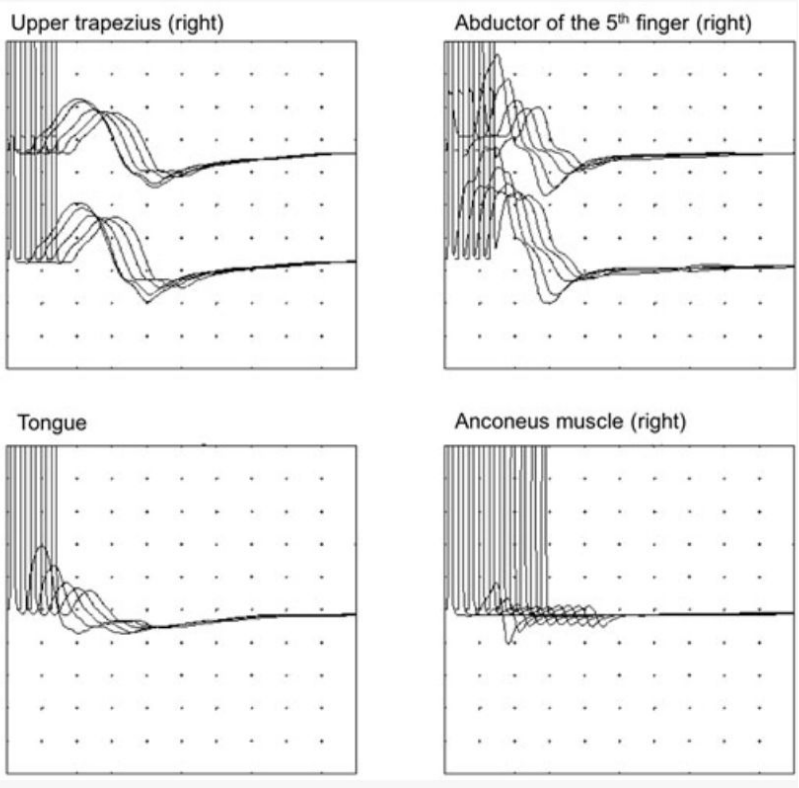


Figure 1: Talia's EMGs. Repetitive nerve stimulation was performed 5-10 times at 3 Hz and surface electrodes were used to record the muscle action potentials. *Image credited to Lucie Guyant-Marchal.*

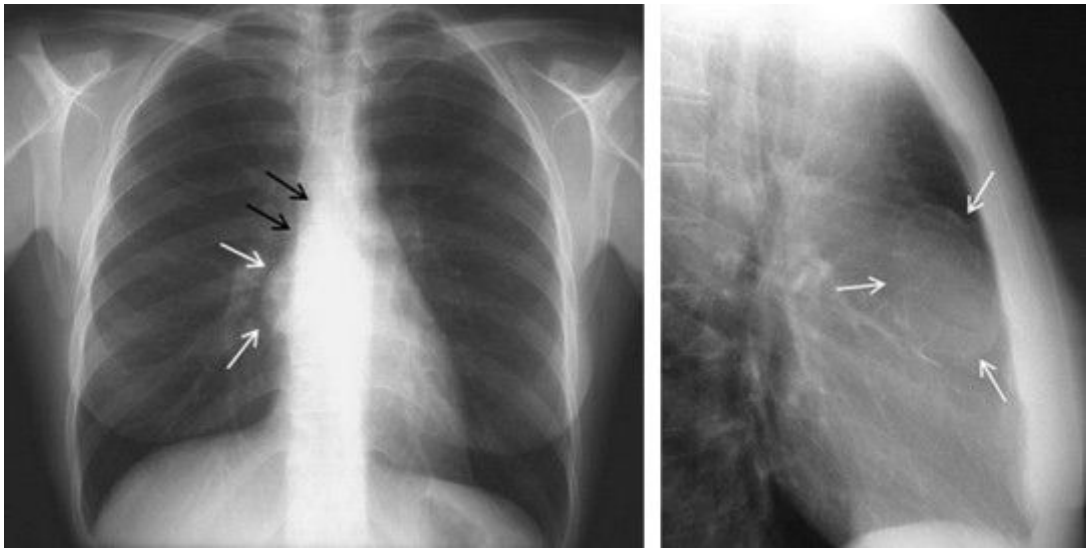


Figure 2: Talia's X-ray, showing a Masaoka-Koga stage I, WHO type AB, small thymoma. *X-ray credit to S.M. Priola*

Figure 3: Talia's examination values. *Values credited to the original case study.*

Examination	**Value**	**Normal Limits**
WBC	7.41	4-12 x10 9 /L
HB	13.8	12.1-15.2 g/L
Platelets	152	(140-450 x10 9 /L)
CRP	5	0-8 mg/l
Na	137	135-147 mmol/L
K	4.2	3.3-5.0 mmol/L
Cl	101	99-103 µmol/L
Urea	6.2	2.5-6.4 mmol/L
Creatinine	68	62-115 mmol/L
CK	183	25-195 IU/L
Total Protein	72	60-80 g/L
Albumin	42	35-50 g/L
Corrected calcium	2.2	2.1-2.6 mmol/L
Phosphate	1.4	1.0-1.5 mmol/L
Magnesium	1.1	0.8-1.3 mmol/L
Thyroid-stimulating hormone	11.3	9-30 mIU/L
Free T4	14.2	10-26 pmol/L
Antinuclear antibodies	Negative	Negative
Myositis-specific antibodies	All negative	All negative
C3	1.17	0.5-1.53 g/L
C4	0.9	0.2-1 g/L
Anti-AChR receptor antibodies	7.50	<0.5 nmol/L
Anti-MuSK antibodies	Negative	Negative
Anti-LRP4 antibodies	Negative	Negative

This case study is inspired by the original study conducted by Dr. Olivier Boyer (Rouen University Hospital, France) and Dr. Audrey Aussy (Faculty of Medicine of Rouen, Normandy, University, France). The EMGs and data table are also **directly credited to this case study. The author does **not** take credit for these materials.*