



**2020 Golden Gate Science Olympiad Invitational Anatomy and Physiology Condensed
Key**

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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!**

Total Possible Score: 343/343

I. Integumentary System

Multiple Choice: Each question is worth **one** point. **(20)**

- | | |
|------------------|-------|
| 1. A | 11. A |
| 2. E | 12. B |
| 3. C | 13. C |
| 4. D | 14. E |
| 5. B | 15. B |
| 6. D TB#1 | 16. D |
| 7. C | 17. E |
| 8. A | 18. E |
| 9. C | 19. A |
| 10. E | 20. K |

True or False: Each question is worth **one** point. You may write **"T"** for True and **"F"** for False.
(10)

- | | |
|------------------|-------|
| 1. T | 6. F |
| 2. F | 7. T |
| 3. F | 8. T |
| 4. T TB#2 | 9. F |
| 5. T | 10. T |

Diagram-based Questions: Each image is worth **three** points. **(12)**

Figure 1.1:

ID: Free nerve ending (1)

INFO: 1 point for any of the following: pain, touch, pressure, stretching

RATE: Award 1 point for any of the following: slow, intermediate, rapid

Figure 1.2

ID: Ruffini corpuscle/Ruffini ending/Bulbous corpuscle

INFO: 1 point for any of the following: skin stretch, kinesthetic sense, control of finger position/movement, continued/sustained pressure, angle change, thermoreception

RATE: Slow

Figure 1.3

ID: Pacinian corpuscles/Lamellar corpuscles

INFO: 1 point for any of the following: gross pressure changes, vibrations, high-velocity changes in joint position

RATE: rapid

Figure 1.4

ID: Meissner's corpuscles/tactile corpuscles

INFO: light touch (0.5 point for touch; **light** must be included for full credit), shape and textural changes in exploratory and discriminatory touch, vibrations

RATE: rapid

Labeling: Each letter is worth **one** point. **(14)**

Figure 1.5

- A. Dermis
- B. Hair follicle
- C. Hair bulb
- D. Epidermis
- E. Arrector pili
- F. Sebaceous (oil) gland
- G. External root sheath
- H. Dermal papilla (0.5 points for epidermal/
papillary ridges/fingerprints - surface
papillae)

Figure 1.6

- A. Stratum corneum
- B. Stratum granulosum
- C. Stratum lucidum
- D. Stratum spinosum
- E. Stratum basale
- F. Dermis

Short Answer: Read and answer the questions below in the most concise way possible.

Complete sentences are **not** required for this section. **(21)**

1. **(5 total)** free edge (1) and lunula (1); the free edge is white because there are no capillaries under it (1); the lunula is white/whitish since the vascular tissue under the lunula does not show (1) because of a thicker region of the epithelium in the area (1)
2. **(11 total)**
 - The Wallace rule of nines (1)
 - (2 points max) 9% (1) if the anterior and posterior surfaces of the head and neck are affected (1)
 - (2 points max) 9% (1) if the anterior and posterior surfaces of each upper limb (1) (award credit if competitor stated a total of 18% for both upper limbs)
 - (2 points max) 36% (4 x 9%) (1) for anterior and posterior surfaces of the trunk, including buttocks (1)
 - (2 points max) 9% (1) for anterior and posterior surfaces of each lower limb (as far as buttocks) (1) (award credit if competitor stated that the total was 36% instead of stating 9% per lower limb)
 - (2 points max) 1% (1) for perineum (1)
3. **(5 total)** Melanosomes (1) are destroyed by fusion with lysosomes (1) and melanin-filled keratinocytes (1) in the stratum corneum (1) are sloughed off (1)

Pathology: Each image is worth **one** point. **(10)**

Figure 1.7: Third degree burn (0.5 point for burn)

Figure 1.8: Poison ivy allergy (accept: Allergic contact dermatitis/contact dermatitis/urushiol-induced contact dermatitis; 0.5 for allergy)

Figure 1.9: Athlete's foot/tinea pedis (0.5 for infection)

Figure 1.10: Carbuncle (0.5 for infection; No credit for boil)

Figure 1.11: Boil (0.5 for infection)

Figure 1.12: Impetigo (0.5 for infection)

Figure 1.13: Melanoma (0.5 for skin cancer. No credit for cancer)

Figure 1.14: Squamous cell carcinoma/SCC (0.5 for skin cancer. No credit for cancer)

Figure 1.15: Squamous cell carcinoma/SCC (0.5 for skin cancer. No credit for cancer).

Figure 1.16: Basal cell carcinoma (0.5 for skin cancer/carcinoma. No credit for cancer/squamous cell carcinoma/melanoma.)

II. Skeletal System

Multiple Choice: Each question is worth **one** point. **(20)**

- | | |
|-------|-------|
| 1. B | 11. C |
| 2. B | 12. C |
| 3. B | 13. D |
| 4. A | 14. A |
| 5. C | 15. B |
| 6. B | 16. D |
| 7. D | 17. C |
| 8. D | 18. B |
| 9. A | 19. D |
| 10. D | 20. C |

Classification: Each question is worth **one** point. **(10)**

- | | |
|-------------|--------------|
| 1. Thoracic | 6. Lumbar |
| 2. Cervical | 7. Lumbar |
| 3. Thoracic | 8. Cervical |
| 4. Lumbar | 9. Cervical |
| 5. Lumbar | 10. Cervical |

Identification: You **may** write AX for axial and AP for appendicular. Each question is worth **two** points. **(10) TB#3**

1. Xiphoid process (1), axial (AX) (1)
2. Ulna (1), appendicular (AP) (1)
3. Glenoid fossa (1), appendicular (AP) (1)
4. Spine/Vertebral column (1), axial (AX) (1)
5. Foot/Ankle (1), appendicular (AP) (1)

Labeling: Each letter is worth **one** point. **(36)**

Figure 2.1

- A. Facet of superior articular process
- B. Vertebral foramen
- C. Facet for head of rib
- D. Spinal cord
- E. Spinous process
- F. Transverse process
- G. Lamina
- H. Pedicle
- I. Vertebral body
- J. Spinal cord
- K. Facet of superior articular process
- L. Spinal nerve
- M. Facet for head of rib
- N. Intervertebral foramen
- O. Intervertebral disc
- P. Vertebral body
- Q. Inferior articular process
- R. Spinous process

Figure 2.2

- A. Calcaneus
- B. Cuboid
- C. Base
- D. Shaft
- E. Head
- F. Talus
- G. Navicular
- H. Third (lateral) cuneiform (0.5 point for cuneiform only, no credit if competitor stated the wrong number e.g. first instead of third)
- I. Second (intermediate) cuneiform (0.5 point for cuneiform only, no credit if competitor stated the wrong number)
- J. First (medial) cuneiform (0.5 point for cuneiform only, no credit if competitor stated the wrong number)
- K. Metatarsals
- L. Sesamoid (bones)
- M. Proximal
- N. Middle
- O. Distal
- P. Great toe/hallux
- Q. Calcaneus
- R. Cuboid

Image-based Questions: Each question is worth **one** point unless stated otherwise. **(12) TB#4**

1. Intramembranous
2. (2) osteoblast
3. (2) nidus
4. Type-I
5. (2) Osteocytes
6. Bone spicules (accept spicules)
7. Primary
8. (2) compact

Pathology: Each image is worth **three** points. **(18)**

1. Fracture (+1 bonus point for scaphoid fracture)
2. Scoliosis
3. Osteoporosis
4. Disc herniation
5. Anterior cruciate ligament (ACL) tear/injury
6. Medial collateral ligament (MCL) tear/injury

III. Muscular System

Multiple Choice: Each question is worth **one** point. There is **no** partial credit for the multiple select question. **(20)**

- | | |
|-------|--|
| 1. B | 11. B |
| 2. D | 12. B |
| 3. A | 13. D |
| 4. A | 14. C |
| 5. C | 15. B, D (no partial credit for this question) |
| 6. C | 16. B |
| 7. B | 17. A |
| 8. C | 18. C |
| 9. A | 19. A |
| 10. D | 20. C |

Identification: Each question is worth **two** points. Be as specific and concise as possible. **(10)**

1. syndesmosis (1 point for fibrous)
2. symphysis (1 point for cartilaginous)
3. synchondrosis
4. condyloid (1 point for synovial)
5. suture

Origin, Insertion, and Function: Each letter is worth **two** points. **(16)**

- A. Masseter
- B. Angle and ramus of mandible
- C. Pectoralis major
- D. Clavicle (clavicular head), sternum, and costal cartilages of ribs 2-6 or ribs 1-8 (sternocostal head) (2 points for all information; 1 point if missing something, 0 points if completely incorrect)
- E. Lateral border of distal end of humerus
- F. Superior to styloid process of radius
- G. Flexor carpi radialis
- H. Flexes and abducts hand (radial deviation) at wrist joint

Image-based Questions: Each question is worth **one** point unless stated otherwise. **(12)**

- 1. Cardiac tissue
- 2. (2) intercalated disc
- 3. Fibroblasts
- 4. T-tubules
- 5. Award 2 points for one of the following:
atrial syncytium, ventricular syncytium
- 6. False
- 7. False
- 8. True
- 9. True
- 10. False

Identification: Each question is worth **one** point. Complete sentences are **not** required for this section. **(10)**

- 1. Titin
- 2. Nebulin
- 3. Myomesin
- 4. Actin
- 5. Myosin
- 6. Troponin
- 7. Dystrophin
- 8. alpha-Actinin/ α -Actinin **TB#5**
- 9. Tropomyosin
- 10. Dystrophin

Labeling: Each letter is worth **one** point. **(33)**

Figure 3.1

- | | |
|--|--------------------------|
| A. Femur | G. Patella |
| B. Posterior cruciate ligament (PCL) | H. Prepatellar bursa |
| C. Anterior cruciate ligament (ACL) | I. Synovial cavity |
| D. Tibia | J. Infrapatellar fat pad |
| E. Tendon of quadriceps femoris
(accept quadriceps femoris) | K. Infrapatellar bursa |
| F. Suprapatellar bursa | L. Patellar ligament |

Figure 3.2

DO NOT PROVIDE PARTIAL CREDIT FOR INCORRECT SPELLING.

- | | | |
|----------------------------|----------------------------|-----------------------------|
| A. Orbicularis oris | H. Vastus medialis | O. Serratus anterior |
| B. Latissimus dorsi | I. Soleus | P. Biceps brachii |
| C. Brachioradialis | J. Masseter | Q. Brachialis |
| D. Tensor fasciae
latae | K. Sternocleidomas
toid | R. Triceps brachii |
| E. Sartorius | L. Trapezius | S. Brachioradialis |
| F. Vastus lateralis | M. Deltoid | T. Flexor carpi
radialis |
| G. Rectus femoris | N. Pectoralis major | U. Tibia |

Pathology: Each image is worth **three** points. **No** partial credit will be awarded for this section.

(18)

1. (Duchenne) Muscular dystrophy
2. Poliomyelitis
3. Myasthenia gravis
4. Myasthenia gravis
5. (Generalized) Tetanus
6. Myositis

IV. Case Study

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

Note: The point values on the left is the total point value. The point values located after each word/phrase/sentence is the points allocated for that specific word/phrase/sentence.

1. (3) Myasthenia gravis (MG)
2. (2) increased
3. (2) Grant 2 points for one of the following: double vision, (bilateral) ptosis, unable to perform squats (muscle weakness)
4. **(6 total)** Talia's EMG shows a decrementing response $> 10\%$ (2), concerns at least 2 muscles/nerves (upper trapezius, abductor of the 5th finger, tongue, anconeus muscle) (2), during a 3 Hz repetitive nerve stimulation (2)
5. (2) Thymectomy
6. (2) True
7. **(8 total)** There is a higher amount of Anti-AChR receptor antibodies than normal (2), which are directed against the ACh receptor (2). As a result, Talia experiences fluctuating striated muscle weakness (2) due to a decrease of ACh (2) at the post-synaptic junction.
8. (2) cholinesterase inhibitor (e.g. pyridostigmine)
9. (2) azathioprine
10. (2) award two points for any of the following: IVIg, plasma exchange, cyclophosphamide, rituximab