



1. **DESCRIPTION:** Participants will be assessed on their understanding of the anatomy and physiology for the **integumentary, skeletal, and muscular systems of the human body.**

**A TEAM OF UP TO:** 2

**CALCULATOR:** Class II

**APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:** Each team may bring one 8.5" x 11" sheet of paper that may contain information on both sides in any form and from any source along with two stand-alone non-programmable, non-graphing calculators (Class II).

3. **THE COMPETITION:** This Event may be administered as a written test or as a series of lab-practical stations which can include but are not limited to experiments, scientific apparatus, models, illustrations, specimens, data collection and analysis, and problems for students to solve. Content topics will include:

a. **INTEGUMENTARY – All levels should understand:**

- i. Functions of the integumentary system (e.g., **physical protection, Vitamin D synthesis, sensation, excretion, temperature regulation, role of the skin in innate immunity**)
- ii. Anatomy and **histological characteristics** of the layers of the skin
- iii. Anatomy and **histological characteristics** of the component parts of the skin: hair (e.g., **types, appearance, growth cycle**), nails, integumentary glands (e.g., **eccrine vs apocrine**), and sensory receptors
- iv. Skin color, skin texture, and the effects of aging on the skin
- v. **Dermatological features** (e.g., **freckles, moles, scales, calluses, birthmarks, fingerprints**)
- vi. The diseases on each level from the cell to the whole person as listed: **wounds affecting the skin (limited to burns and their classification, sunburn), allergens** (e.g., poison ivy, metals), human papillomavirus (HPV), **infections (limited to boils, carbuncles, athlete's foot, impetigo, erysipelas, cellulitis, Hansen's Disease, chickenpox, shingles), common inflammatory disorders** (limited to psoriasis, dermatitis), and skin cancer (**limited to melanoma, basal cell carcinoma, squamous cell carcinoma, Kaposi's sarcoma, Merkel cell carcinoma**)
- vii. Treatments and/or prevention for all conditions listed above (drugs, surgery, etc.)

**State and National Level Only:**

- viii. Cellular components of cutaneous immune system (e.g., dermal dendritic cells, dermal macrophages)
- ix. Additional disorders: immunologic and inflammatory disorders (limited to rosacea, vitiligo, bullous pemphigoid, Stevens-Johnson syndrome, erythema nodosum, erythema multiforme, alopecia)

**National Level Only:**

- x. Additional disorders: **Congenital disorders (limited to albinism, xeroderma pigmentosum), systemic disorders and their effect on skin (limited to acanthosis nigricans), benign lesions (limited to actinic keratosis)**
- xi. Treatments and/or prevention for all conditions listed above (drugs, surgery, etc.)
- xii. Aspects of wound healing including, but not limited to: inflammation, necrosis, apoptosis, vasodilation, and clotting

b. **SKELETAL SYSTEM – All levels should know and understand:**

- i. Bones of the axial and appendicular skeleton; label the basic surface anatomy of a bone as shown on a diagram and/or normal X-ray, CT and MRI
- ii. Name, structure and function of joint types and muscle, **tendon** and ligament attachments that surround the joints and the ranges of motion allowed by each type (e.g., ball and socket)
- iii. **Structure and microscopic function of bones, bone marrow and cartilage** (e.g., **storage, osteon, blood cell production**)
- iv. **Tension production** (e.g., **sarcomere length-tension relationship, muscle twitches, motor units**)
- v. **Skeletal system role in calcium and phosphate balance**
- vi. **Effect of hormones** (e.g., **PTH, vitamin D, estrogen**) on the skeletal system
- vii. **Cellular composition of bones** (e.g., **RANKL role in bone cell maturation**), bone marrow and cartilage
- viii. **Development and maturation of bones at the cellular and gross anatomical levels**
- ix. Types of vertebrae (e.g., cervical, thoracic and lumbar)
- x. Characteristics and radiological features of bone diseases/disorders from the cell level to the whole person as listed: **osteoarthritis and rheumatoid arthritis (know how to distinguish both from one another), gout, osteoporosis, osteomalacia/rickets, scoliosis, kyphosis, lordosis, Tennis elbow, Golfer's elbow, cruciate ligament tears of the knee, meniscus tears of the knee, and septic arthritis**



- xi. The effects of exercise and aging on the skeletal system and the diseases mentioned
- xii. **Cardiac and smooth muscle roles in the body (e.g., blood circulation, digestive motility)**
- xiii. **Fractures, including the Salter-Harris fracture classification system, causes, and treatments**

## State and National Level Only:

- xiv. Additional diseases/disorders: spinal fractures (**including specific classes**), ankylosing spondylitis, achondroplasia, osteosarcoma, **and Ewing sarcoma**

## National Level Only:

- xv. Additional diseases/disorders to know: **clinical effects of spinal stenosis, foraminal stenosis, and disc herniation on the nervous system, Osgood-Schlatter disease, plantar fasciitis, Paget disease of bone (osteitis deformans), osteoblastoma, giant cell tumor**
- xvi. Treatments and/or prevention for all conditions listed above (drugs, surgery, etc.)
- xvii. **Label the bones and sutures of the skull. Know the foramina of the skull and what neurovascular structures pass through each.**

## c. MUSCULAR SYSTEM - All levels should know:

- i. **Functions of the muscular system (e.g., movement, blood circulation, heat production)**
- ii. The interaction of the skeletal and muscular systems to allow movement and **maintain posture**
- iii. **The cellular and gross anatomy of skeletal muscle, cardiac muscle and smooth muscle**
- iv. **Tension Production (e.g., sarcomere length-tension relationship, muscle twitches, motor units)**
- v. **Physiology of the skeletal muscle contraction and relaxation (e.g., neuromuscular junction, excitation-contraction coupling, cross-bridge cycling)**
- vi. **Concepts of skeletal muscle actions (e.g., agonist, antagonist, synergist muscles) of different muscles on the 2025 National Major Skeletal Muscles List**
- vii. Location and identification (e.g., origin, insertion, function) of the muscles on the 2025 National Major Skeletal Muscles List
- viii. Exercise and aging effects on the cellular and gross anatomical structure of the muscular system
- ix. Muscle and tendon injuries and their prevention (**limited to strains and sprains**)
- x. The diseases on each level from the cell to the whole person as listed: **neuromuscular junction disorders (limited to myasthenia gravis, Lambert-Eaton myasthenic syndrome), immunologic and inflammatory disorders (limited to polymyalgia rheumatica, polymyositis, and dermatomyositis), infectious disorders (limited to botulism, tetanus, poliomyelitis), and pain syndromes (limited to fibromyalgia, chronic fatigue syndrome, Carpal Tunnel Syndrome)**

## State and National Level Only:

- xi. **Energy metabolism in skeletal muscles (limited to phosphocreatine system, glycogen storage and consumption)**
- xii. **Additional diseases: rhabdomyolysis, Duchenne muscular dystrophy, myotonic dystrophy**
- xiii. **Cardiac and smooth muscle roles in the body (e.g., blood circulation, digestive motility)**

## National Level Only:

- xiv. Nerve innervation for all muscles on the 2025 National Major Skeletal Muscles List
- xv. **Muscle reflexes (limited to Golgi tendon organ, muscle spindle fibers)**
- xvi. Additional diseases: **congenital disorders and iatrogenic disorders (limited to drug-induced myositis, malignant hyperthermia)**
- xvii. Treatments and/or prevention for all conditions listed above (drugs, surgery, etc.)
- xviii. **Effects of steroid medications on muscle health**

## 4. SCORING:

- a. High score wins.
- b. Selected questions will be used to break ties.

**Recommended Resources:** The Science Olympiad Store ([store.soinc.org](http://store.soinc.org)) carries a variety of resources to purchase; other resources are on the Event Pages at [soinc.org](http://soinc.org).

**Head and Neck**

Frontalis  
Orbicularis oris  
Orbicularis oculi  
Occipitofrontalis  
Zygomaticus major  
Masseter  
Sternocleidomastoid  
Trapezius  
Buccinator

**Move the Upper Extremities**

Pectoralis major  
Latissimus dorsi  
Deltoid  
Teres major  
Biceps brachii  
Triceps brachii  
Brachialis  
Brachioradialis  
Palmaris longus  
Flexor carpi radialis  
Flexor digitorum superficialis  
Extensor carpi radialis  
Extensor digitorum  
Extensor digiti minimi  
Extensor carpi ulnaris  
Infraspinatus  
Supraspinatus  
Subscapularis  
Teres Minor

**Muscles of the Trunk**

External intercostals  
Internal intercostals  
Transverse abdominis  
Rectus abdominis  
Serratus anterior  
Diaphragm

**Move the Lower Extremities**

Iliopsoas  
Sartorius  
Gluteus maximus  
Gluteus medius  
Tensor fasciae latae  
Adductor longus  
Gracilis  
Semimembranosus  
Semitendinosus  
Biceps femoris  
Rectus femoris  
Vastus lateralis  
Vastus intermedius  
Vastus medialis  
Tibialis anterior  
Gastrocnemius  
Soleus  
Peroneus longus  
Peroneus brevis