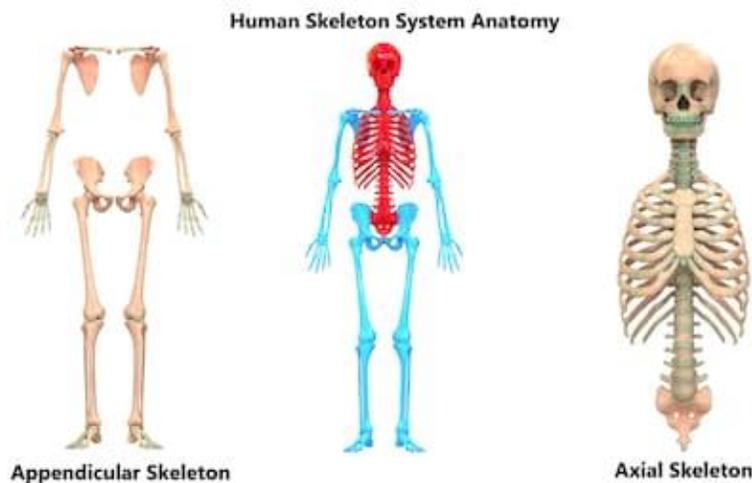


# Human Machine 2020 Skeletal and Muscular Systems Study Guide/Outline

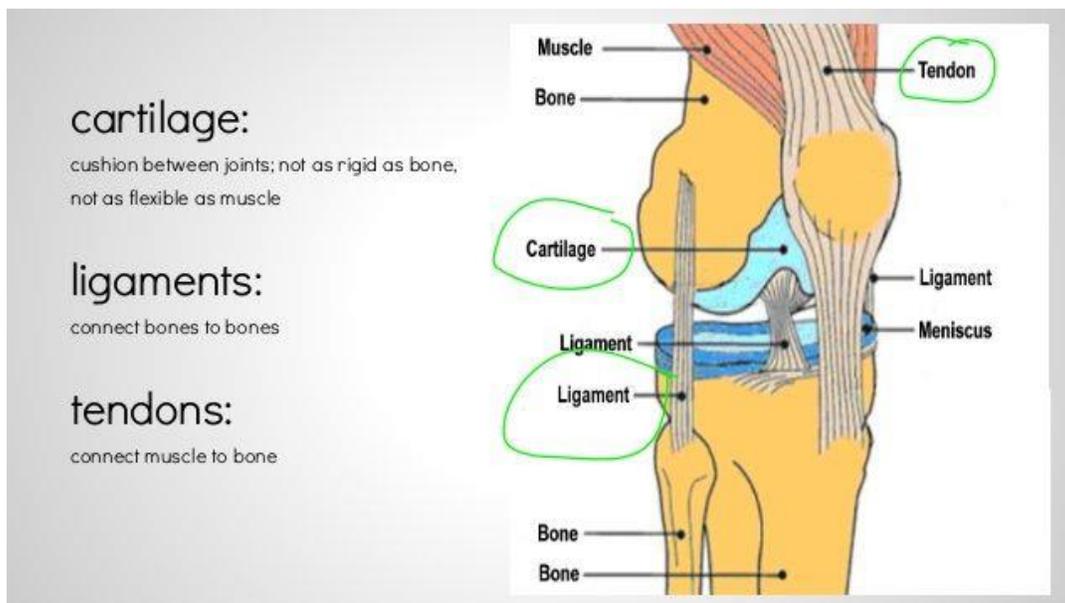
*This study guide is intended to help coaches understand the topics the event will cover and the level of comprehension expected for those topics. It is recommended and expected that additional materials, websites and activities be used to help prepare the teams for this event. All concepts listed below are required for both 2<sup>nd</sup> and 3<sup>rd</sup> grade unless indicated. (3<sup>rd</sup> grade only information is indicated by an asterisk)*

## 1. Skeletal System

- **Function(s)** - The skeletal system supports and shapes the overall structure of the body and provides protection for the internal organs. It is comprised of bones, ligaments and tendons. It stores minerals like calcium and phosphorus, lipids, and produces blood cells. The skeletal system and the muscular system work together to help you move.
- **Major Structures/Organs:**
  - **Bones** - 70% of bone is made up of hard minerals like calcium. It also contains blood vessels and many bones have a soft center section called marrow. Blood cells are made in the bone marrow.
    - 206 Bones (teams do not need to know all the bones!)
    - *Axial Skeleton:* (80 bones) in skull, vertebrae, ribs, sternum
    - *Appendicular Skeleton:* (126 bones)- upper & lower extremities plus two girdles
    - Half of all bones are in hands & feet



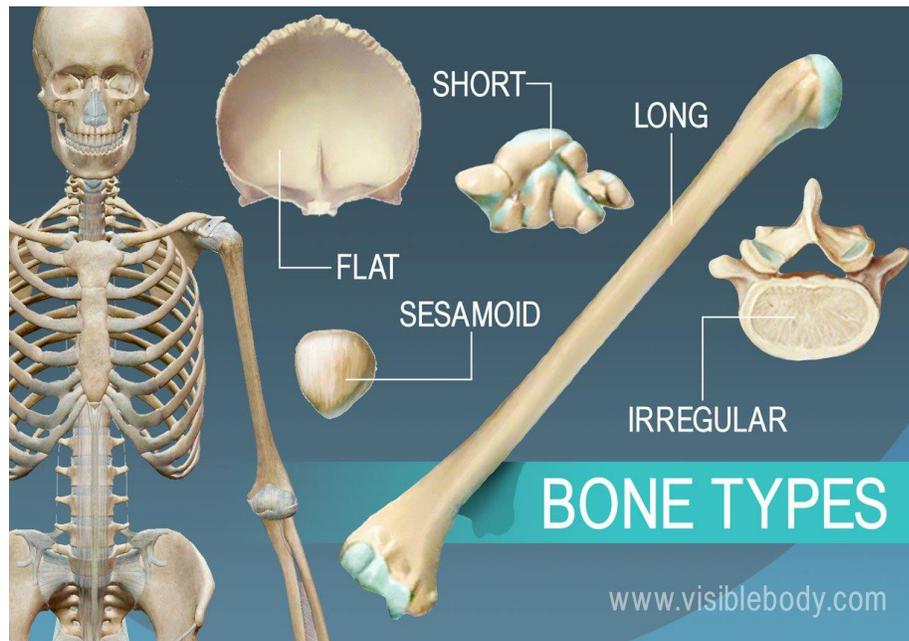
- **Ligaments** - Bands of tissue made of collagen that attach bones to other bones
- **Tendons** - Bands of tissue made of collagen that attach bones to muscles
- **Cartilage** -
  - Cartilage is a tough, resilient, and smooth elastic tissue that functions as a rubber-like pad covering and protecting the ends of long bones at the joints, and is a structural part of the rib cage, intervertebral discs, and many other body components.
  - It is not as hard and rigid as bone, but is stiffer and less flexible than muscle.
  - Cartilage is mostly water and does not contain blood vessels or nerves.
- **Joints:** Bones are joined together at locations called joints. Joints are linked together by cartilage. Joints allow for movement of bones.



- **Types of bone**

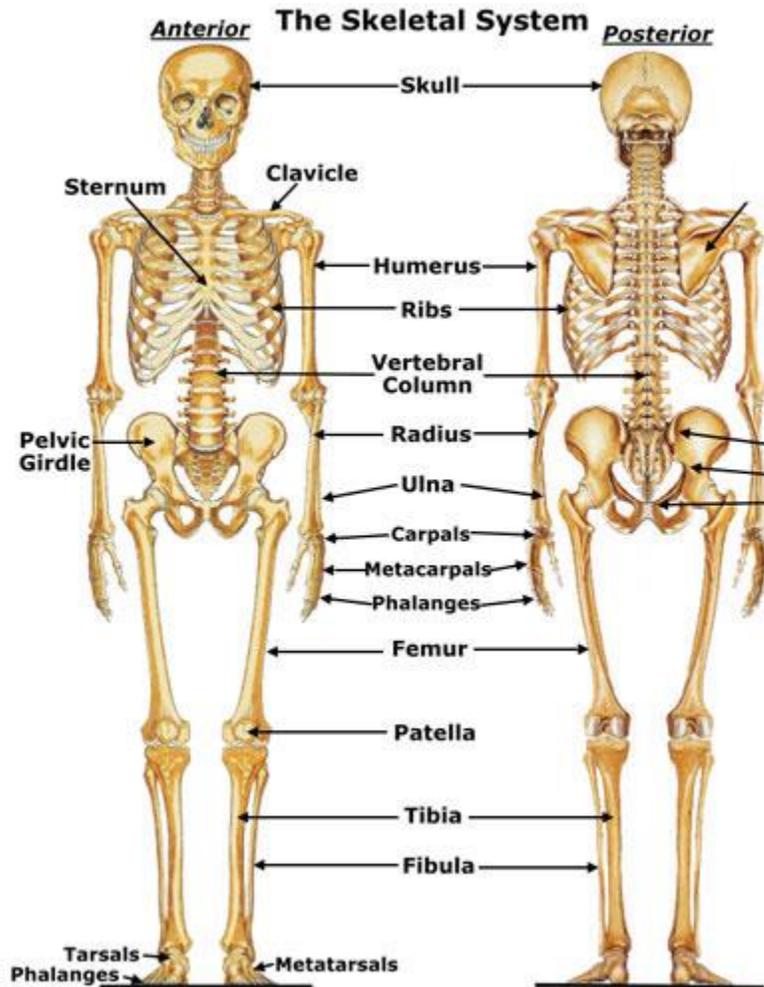
- **Long bones:** long bones are longer than they are wide and help with movement and support the body. Examples of long bones include humerus, ulna, and femur.
- **Short bones:** short bones are cube shaped. Examples of these are the small bones that make up the base of your hands and feet (carpals, tarsals).

- **Flat bones:** flattened bones that provide protection (like a shield)  
Examples of flat bones include cranial bones, pelvis, and ribs
- **Irregular bones:** irregular bones have a variety of shapes.  
Examples of irregular bones include the vertebrae bones.
- **Sesamoid bones:** short bones within tendons (e.g.: patella)



- **Major Bones** - Teams should know the names, type and location of the following bones:
  - Cranium/skull
  - Clavicle
  - Vertebral column
  - Sternum
  - Ribs
  - Humerus
  - Radius
  - Ulna
  - Carpals
  - Metacarpals
  - Phalanges
  - Pelvic girdle
  - Femur
  - Patella
  - Tibia
  - Fibula

- Tarsals
- Metatarsals
- Phalanges



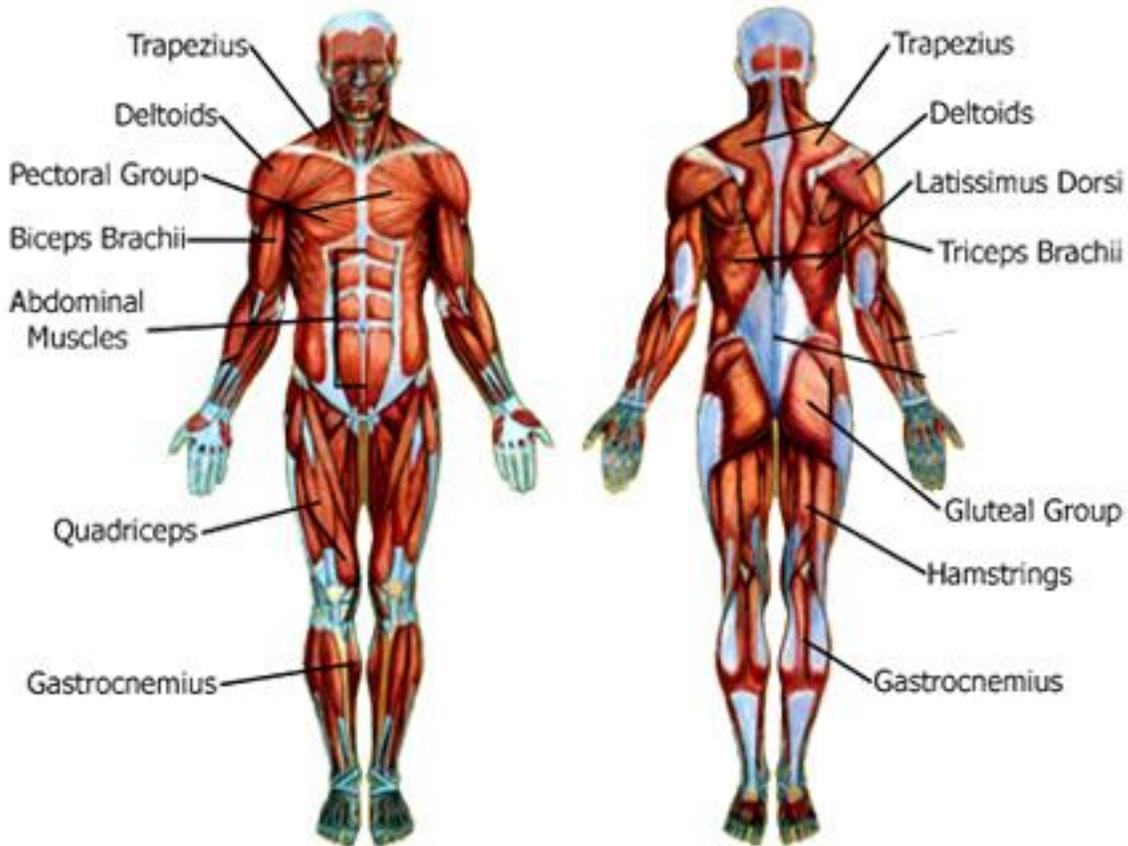
## 2. Muscular System

- **Function(s)** - The function of the muscular system is to move your body and everything in your body. Sometimes you move your muscles consciously like when you walk down the stairs and other times your muscles move unconsciously like when your heart muscles beat or when food passes through your body.

- **Types of Muscle:** Know the three main types of muscle, their functions, where they are located, and how they differ from the other two types.
  - **Skeletal** - Skeletal muscle is found in your arms and legs and anywhere else in your body that you can control and move.
    - Skeletal muscles produce movement by bending the skeleton at movable joints.
    - Voluntary muscles: consciously control to move
  - **Smooth** - Smooth muscle is found in the digestive system, airways and other organs where it functions to keep those other systems working properly.
    - Smooth muscle moves involuntarily.
  - **Cardiac** - Cardiac muscle is specifically found in the heart and contracts (beats) continuously.
    - Cardiac muscle also moves involuntarily, we do not have to think about our heart beating for it to beat.
- **Major Muscles** - Teams should know the names, type and location of the following muscles:
  - Trapezius
  - Deltoids
  - Pectoral Group
  - Biceps Brachii
  - Abdominal Muscles
  - Quadriceps
  - Gastrocnemius
  - \*Latissimus Dorsi
  - Triceps Brachii
  - \*Gluteal Group
  - Hamstring Group

\* 3rd grade only

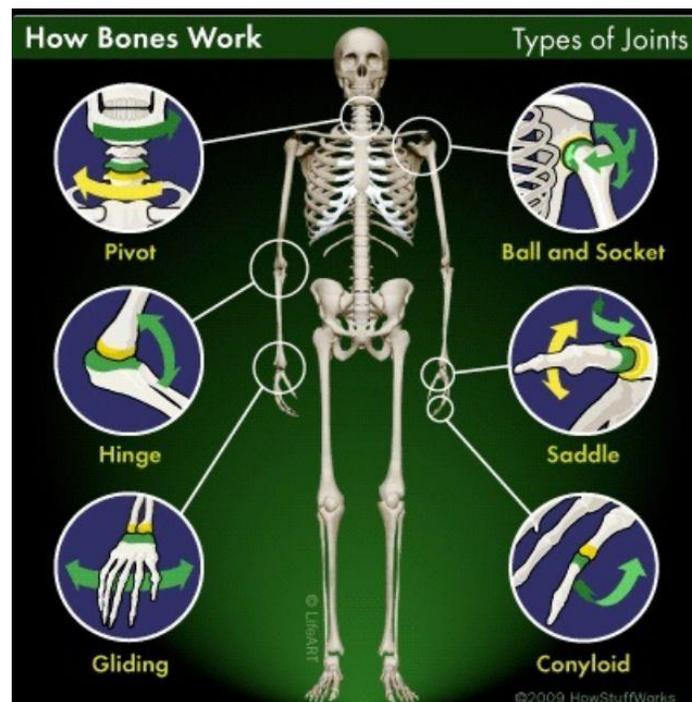
## THE MAJOR MUSCLE GROUPS



- Muscles work in **antagonistic** pairs:
  - Muscles can pull bones, but they can't push them back to the original position. So, they work in pairs of flexors and extensors.
  - If one muscle contracts, then another muscle must relax. Think about flexing your arm. The biceps muscle contracts while the triceps muscle relaxes.
  - Know these antagonist pairs
    - Biceps/Triceps
    - Quadriceps/Hamstrings
    - Pectoral Group/Trapezius

### 3. \*Muscular and Skeletal system cooperation (how they work together) - 3rd grade only

- Joints are where two bones meet. They make the skeleton flexible — without them, movement would be impossible.
  - Muscles attached to bone on both sides of a joint
  - Muscle contracts/shortens across a joint and moves the bone
  - Joints are classified by their range of motion
    - Some joints do not move at all, like the bones in our skull.
    - The main joints of the body that allow for a lot of range of motion are called synovial or movable joints
- **Some Types of Movable Joints**
  - **Ball & Socket** - allows for complete range of motion
    - Example: shoulder, hip
  - **Pivot** – one bone pivots in the arch of another
    - Example: Top of the vertebral column contains a pivot joint that allows you to nod your head
  - **Hinge** – like door hinge – bending & extending
    - Example: elbow, knee, finger joints

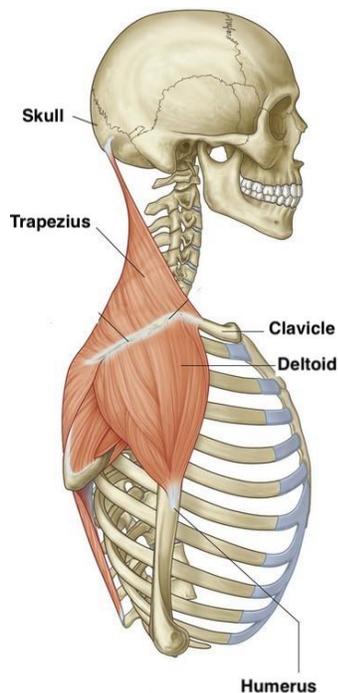


\*Do not need to know condyloid, saddle, or gliding joints

- **Bones and Muscle Relationships**

- Please note this is not an extensive list of all the bone/muscle interactions and some muscles may interact with more bones than we expect you to know for this event.

Muscle or Muscle Group	Bone or Bones of Attachment
Trapezius	Skull bones, Clavicle
Deltoid	Clavicle, Humerus
Pectoral Group	Clavicle, Humerus, Ribs, Sternum
Biceps Brachii	Biceps, Radius
Abdominal Muscles	Ribs, Pelvic Girdle
Quadriceps	Femur, Patella
Gastrocnemius	Femur
Latissimus Dorsi	Vertebral Column, Humerus
Triceps Brachii	Humerus
Gluteal Group	Pelvic Girdle
Hamstring Group	Tibia, Fibula

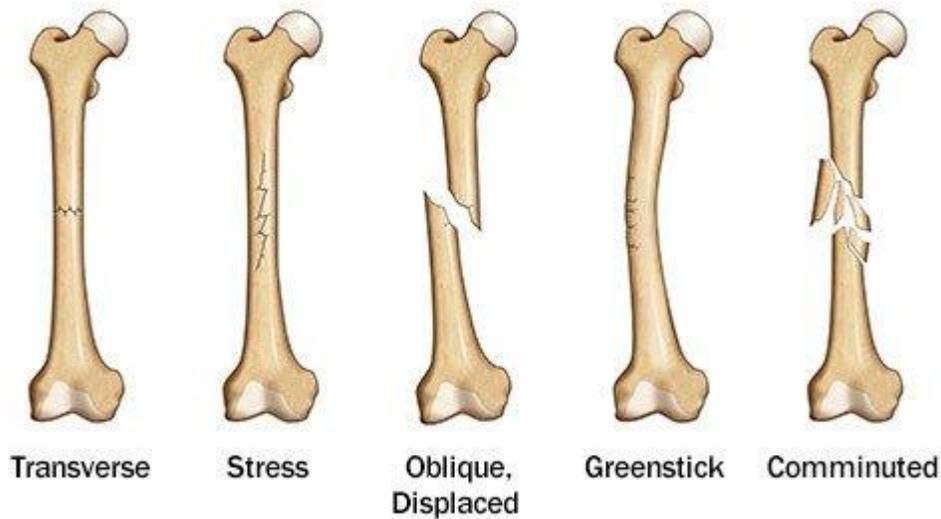


Sample picture for several of the muscle bone relationships.

#### 4. Common trauma to muscles and bones

- **Bone Fractures**

- Transverse – the fracture is perpendicular to the long axis of the bone
- Stress/Fissure - small cracks in the bone
- Oblique – diagonal breaks across the bone
- Greenstick – incomplete fracture – one side of the bone breaks and the other side bends; common in children
- Comminuted - bone fragments into 3 or more pieces



- **Sprains:**
  - The ligaments reinforcing a joint are stretched or torn
  - Partially torn ligaments slowly repair themselves
  - Completely torn ligaments require prompt surgical repair
- **Strains:**
  - Overuse of muscles, such as making the same movements repeatedly over time can cause joints, tendons, or muscles to become irritated and inflamed.
- **Contusions: no longer required for this year's exam**
- **Cramps:**
  - Cramps occur when the muscle contracts suddenly when it is not supposed to
  - Cramps can be caused by muscle strain or dehydration.

## 5. Proper care of Musculoskeletal system

- Preventative Care:
  - Always wear helmets, pads, and the right protective gear for your activity or sport.
  - Get a lot of physical activity, especially stuff like jumping and running.
  - Feed your bones the calcium and vitamin D they need to stay strong. That means getting your share of milk and/or dairy foods, like cheese and yogurt (kids age 9 and older should have 3-4 cups daily), and other calcium and vitamin D-rich foods and drinks, such as broccoli, fish, eggs, and calcium-fortified orange juice.
  - Prevent overuse injuries by resting when you feel tired.
  - Warm-up and stretch before strenuous activity to prevent muscle tear.
  - Drink plenty of water to avoid dehydration and potential muscle cramps.
- Care for an injury:
  - RICE: rest, ice, compress/immobilize, elevate
  - X-rays
  - Slings
  - Casts/Splints
  - Surgery

6. Sample Practical Station Questions (Real X-rays would be used in the event)



**Fill in the Blank:**

Using the x-ray at this station (above), describe the type of fracture in this x-ray:  
**Oblique**

Where is the injury located (what bone(s) is/are involved)? **Radius**

**Multiple Choice:**

One way to avoid a fracture like above is to build strong bones. What would be the best snack for healthy, strong bones:

- a. A slice of watermelon
- b. A Capri Sun Mountain Cooler drink
- c. A chocolate frosted donut
- d. A serving of broccoli and cheese**

6. **References**

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- <https://kidshealth.org/en/kids/broken-bones.html>
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