Chapter 7

The Muscular System: Movement for the Journey

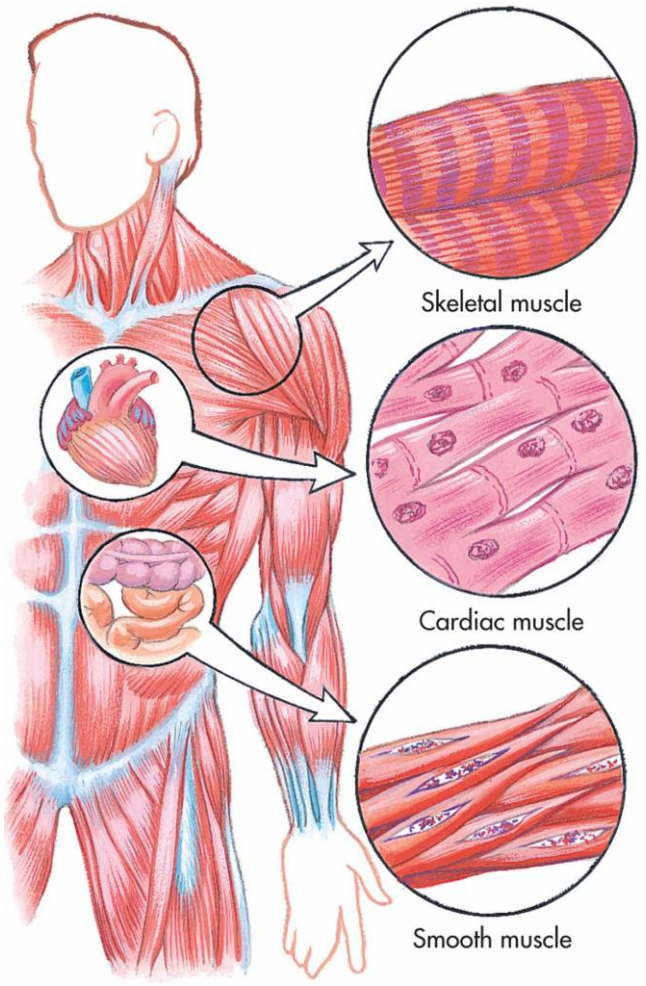
Muscular System

- The muscular system allows for movement.
  - External motion of the arms and legs
  - Internal motion including the movement of the digestive system, the cardiovascular system, and the respiratory system

- **Muscle** is a general term for all contractile tissue.
  - Contraction is when muscle tissue becomes short and thick because of a nerve impulse.
  - Relaxation when impulse ends
  - Alternating contraction and relaxation causes movement.
- Muscle tissue is constructed of bundles of these fibers, approximately the thickness of human hair.

Types of Muscles

- The body has three major types of muscles:
  A. Skeletal muscle
  B. Smooth muscle
  C. Cardiac muscle



Skeletal Muscle

- **Skeletal muscles** are attached to bones and provide movement for the body
  - They are striated (look striped)
  - Movement is voluntary (controlled by conscious thought)
  - Tendons are fibrous tissues that attach skeletal muscles to bones

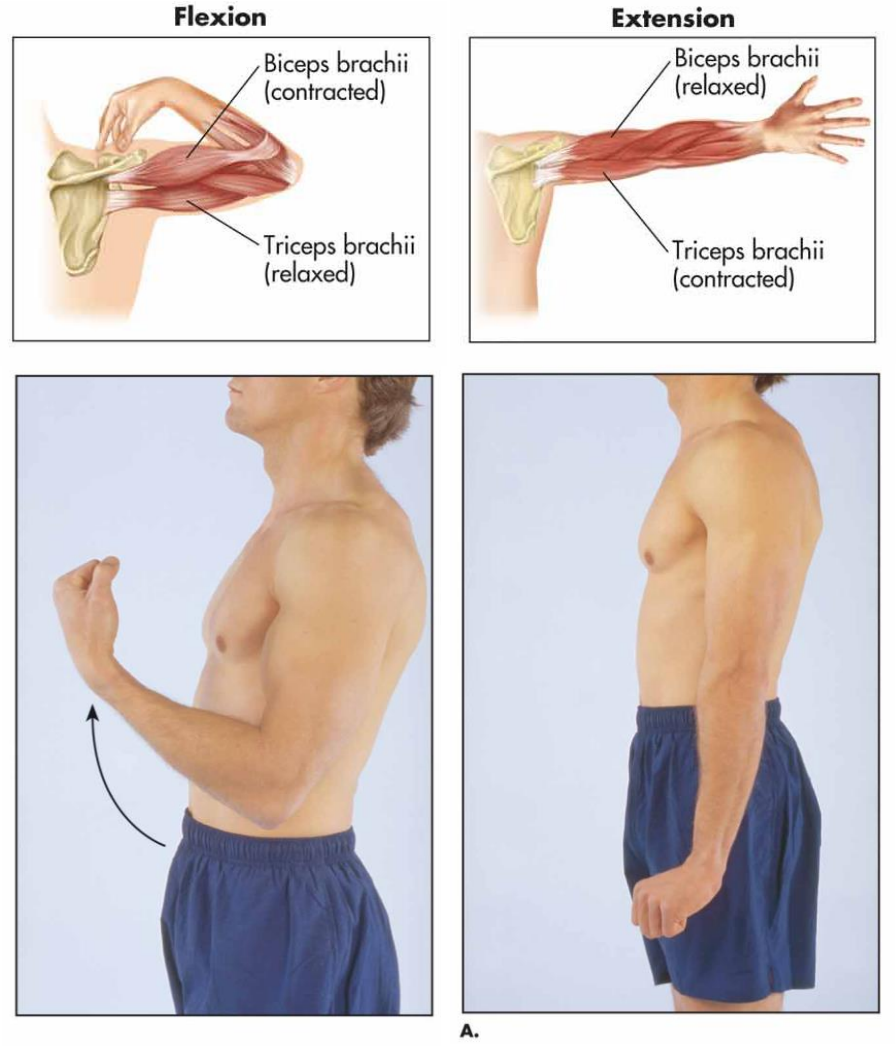
- Contraction and relaxation allows for all movement
  - **Contraction** refers to the shortening of muscle
  - When primary movers contract, opposing muscles relax.

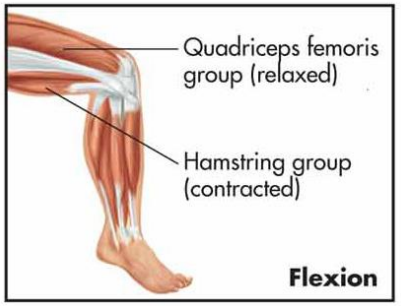
Skeletal muscle

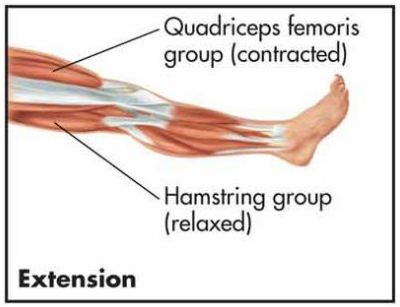
Skeletal Muscle

- Types of Movements
  - **Rotation**: circular movement that occurs around an axis
  - **Abduction**: movement away from midline
  - **Adduction**: movement toward the midline
  - **Extension**: Increasing the angle between two bones connected at a joint
  - **Flexion**: decreasing the angle between two bones

Skeletal Muscle: Flexion & Extension



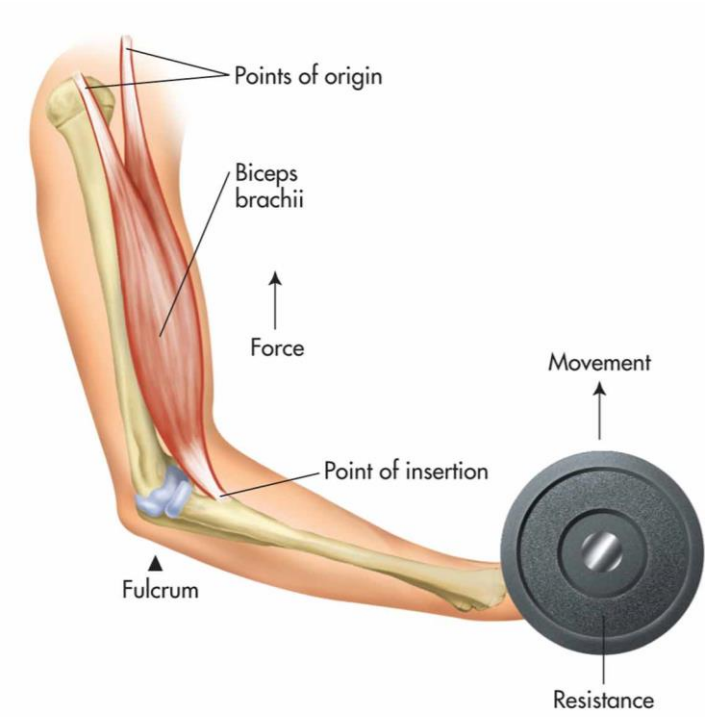




Coordination of Antagonist Muscles

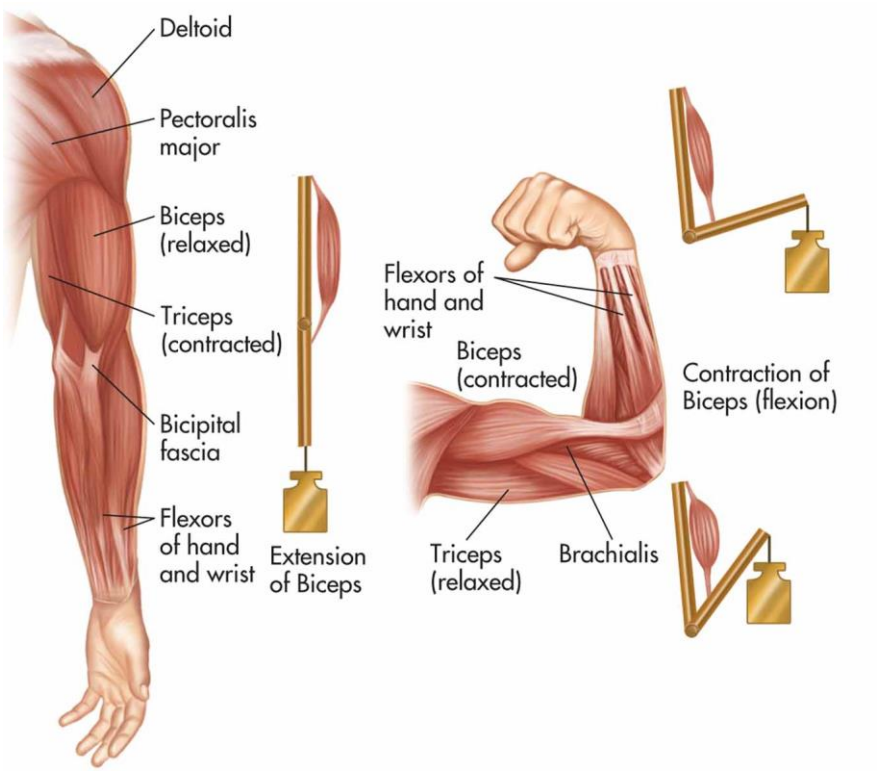
- The primary mover (or agonist) is the chief muscle causing movement.

- **Point of origin** – The end of the muscle that is attached to the stationary bone
- **Point of insertion** – Muscle end attached to the moving bone



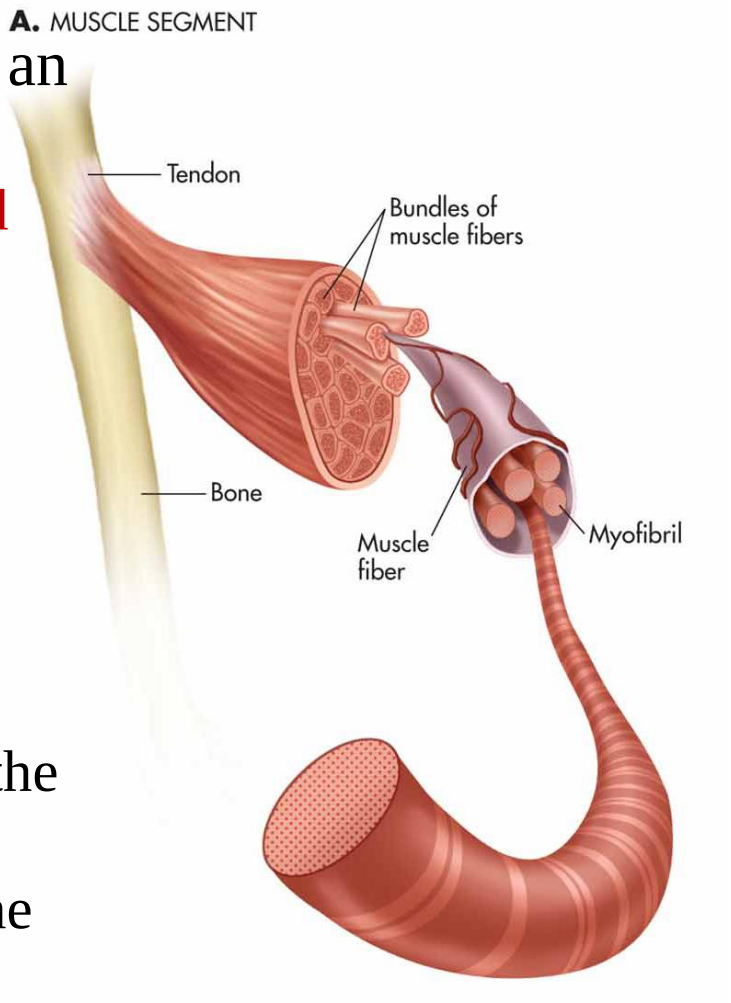
Coordination of Antagonist Muscles

- **Extensor** – the muscle that straightens the joint.
- **Flexor** – the muscle that bends the joint.

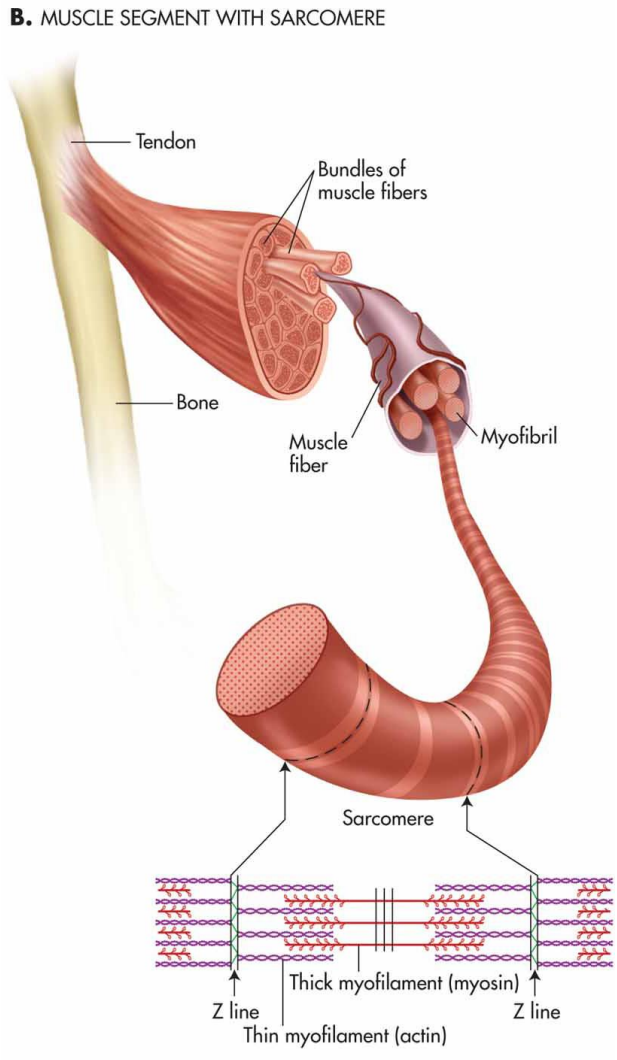


Skeletal Muscles: Movement at the Cellular Level

- **Muscle Fibers -** Each muscle cell is an elongated fiber.
  - Several muscle fibers can be bundled together to form a specific muscle segment.
- **Sarcomeres** are the functional contractile units of each fiber.
  - Each sarcomere has two types of threadlike structures called thick and thin myofilaments.
  - Thick myofilaments are made up of the protein myosin.
  - Thin myofilaments are made up of the protein actin.

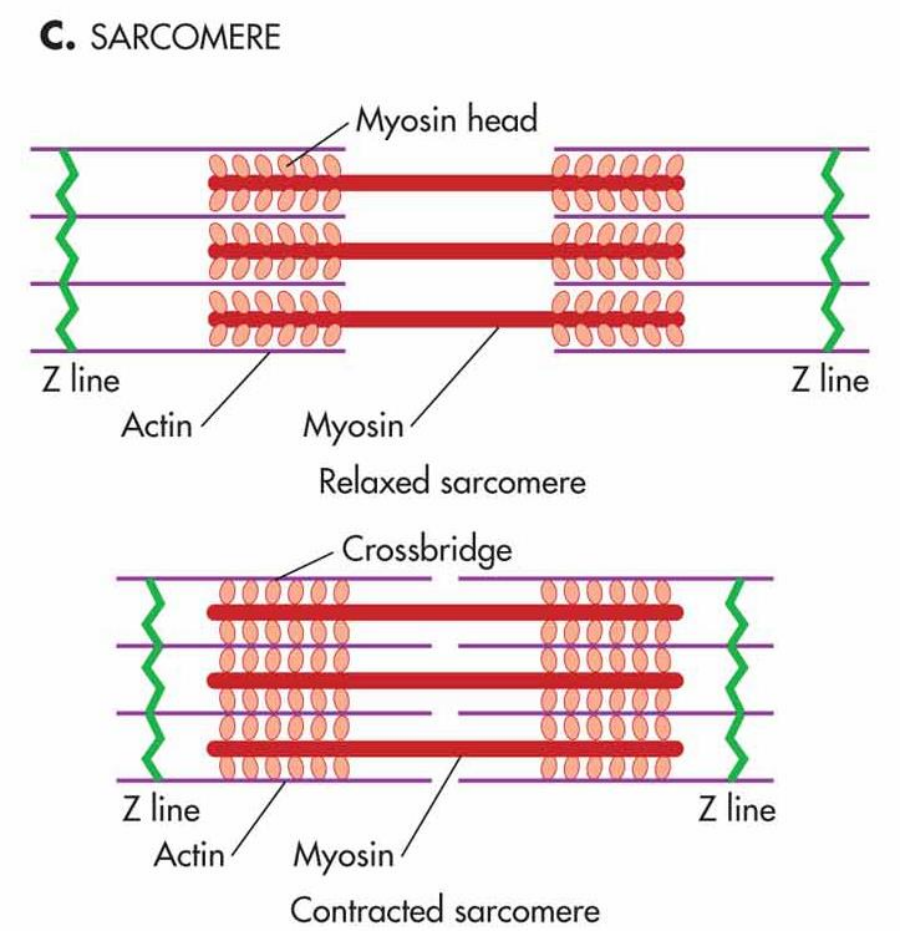


Skeletal Muscle



Skeletal Muscle: Sarcomere

- **Muscle Contraction**
  - Acetylcholine, a neurotransmitter, is released from the nervous system.
  - This causes contraction by causing myosin heads to bind to actin filaments (crossbridge formation).
  - Energy is needed for contraction and relaxation.
    - ATP (adenosine triphosphate)



Skeletal Muscles: Movement at the Cellular Level

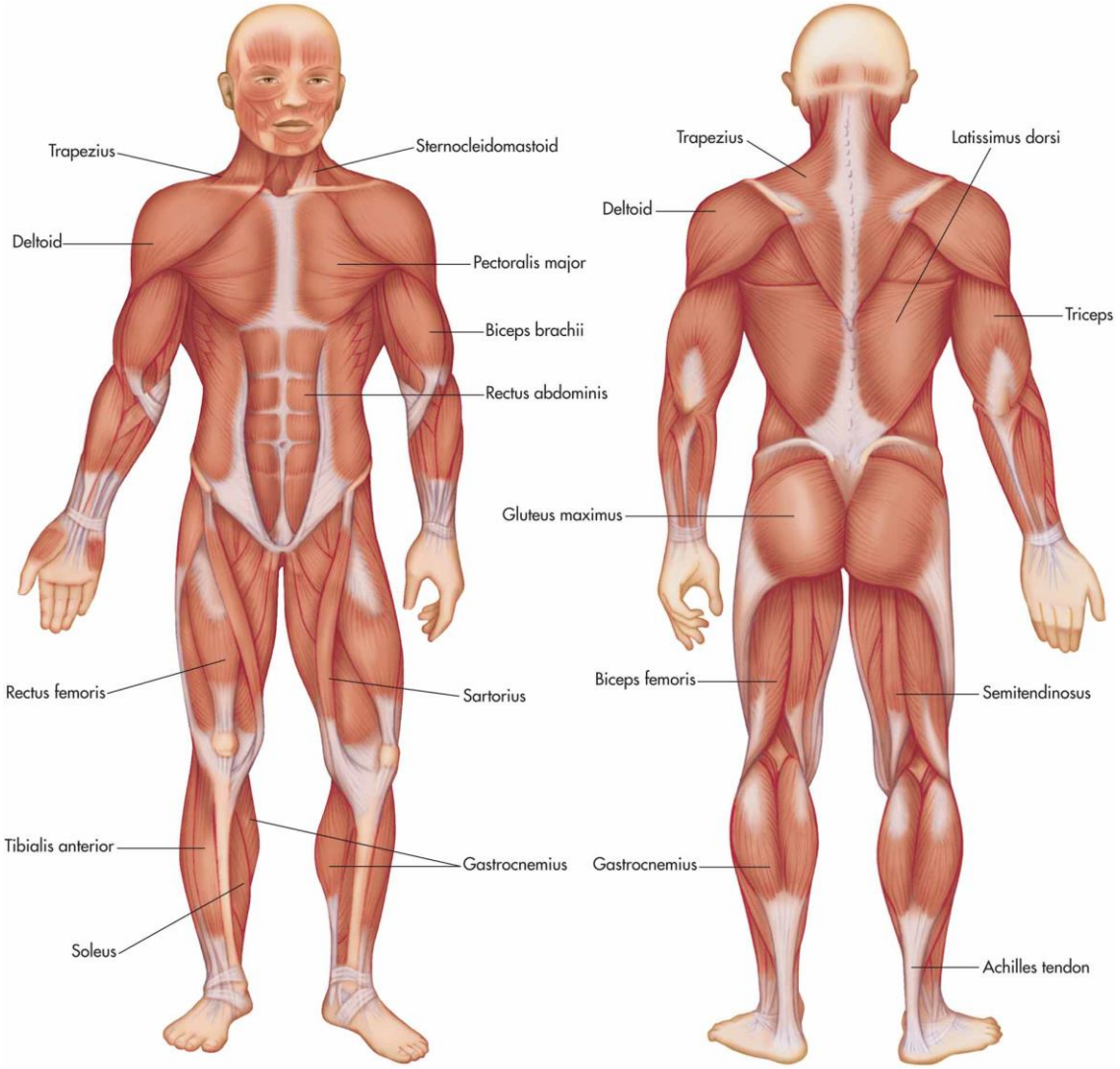
- **Muscular Fuel**
  - Oxygen and glucose to make ATP
  - Glycogen stored in muscle can be converted to glucose.
  - Fat can be stored for energy.
  - Muscle blood supply and color.
    - Higher demand muscles also have a greater blood supply to carry much-needed oxygen.
    - The greater blood supply gives them a darker color.

Skeletal Muscles: Movement at the Cellular Level

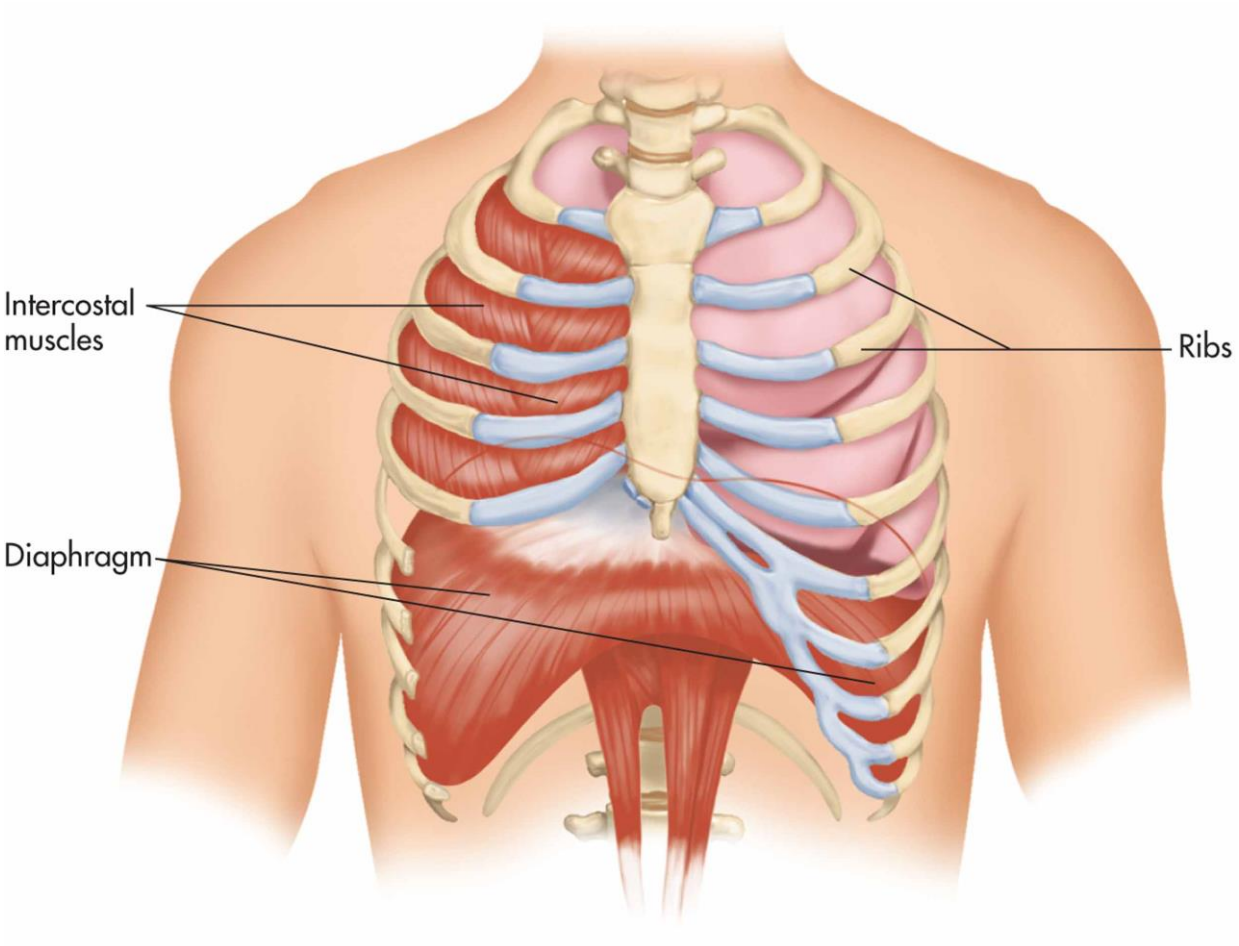
- **Muscles and Body Temperature**
  - Muscles produce heat
  - Producing heat is important in maintaining body temperature
  - Shivering

- **Rigor Mortis**
  - When a body dies, all the stored calcium is unable to be pumped back out of the muscles
  - Excess calcium remains in the muscles throughout the body and causes muscle fibers to shorten and stiffen the whole body
  - Shortage of ATP also contributes

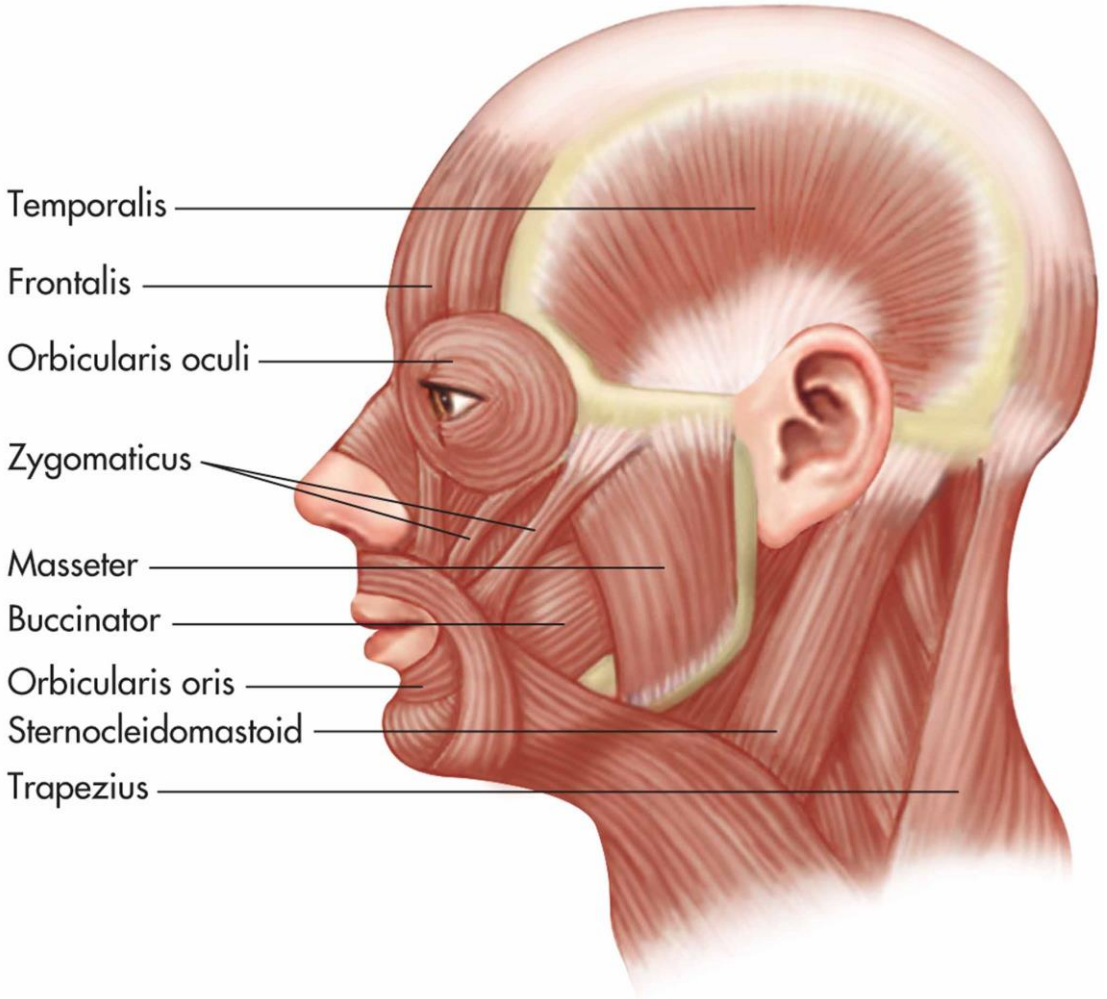
Skeletal Muscles



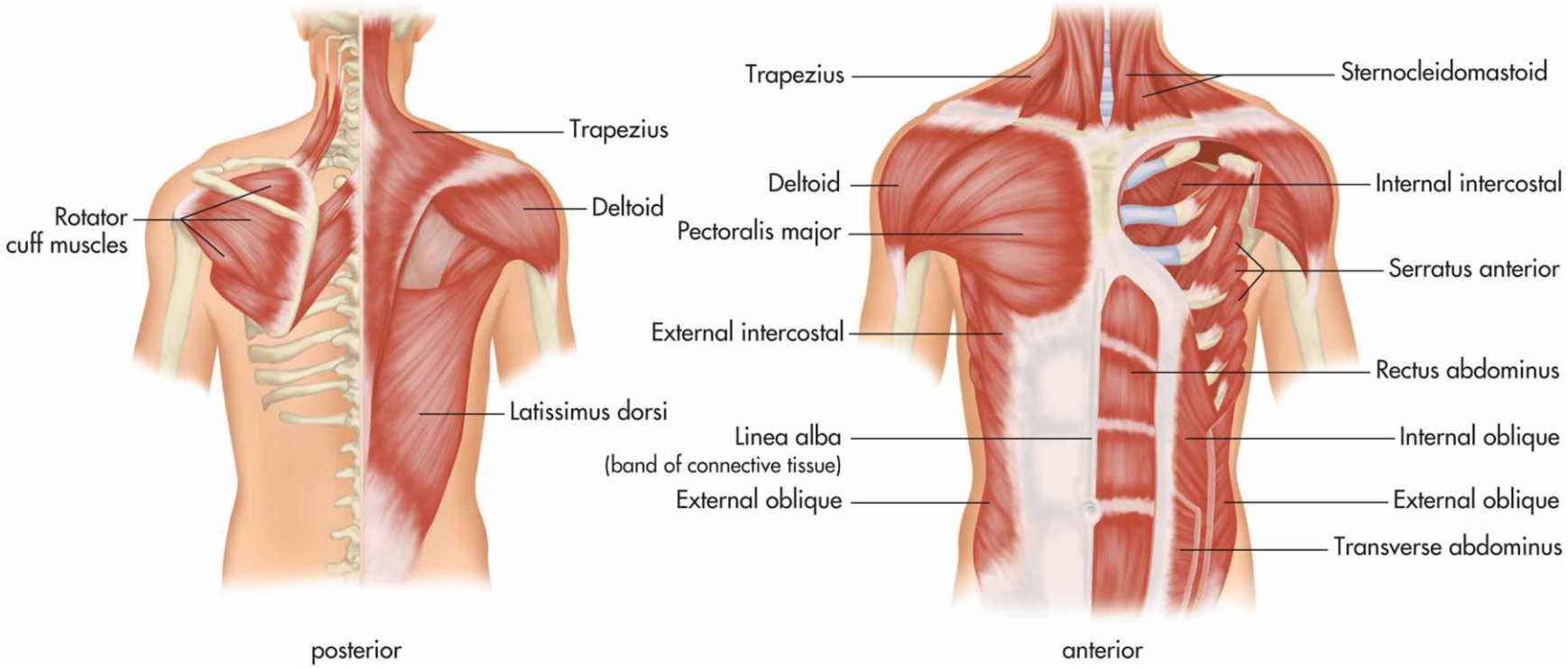
Skeletal Muscles: The Diaphragm



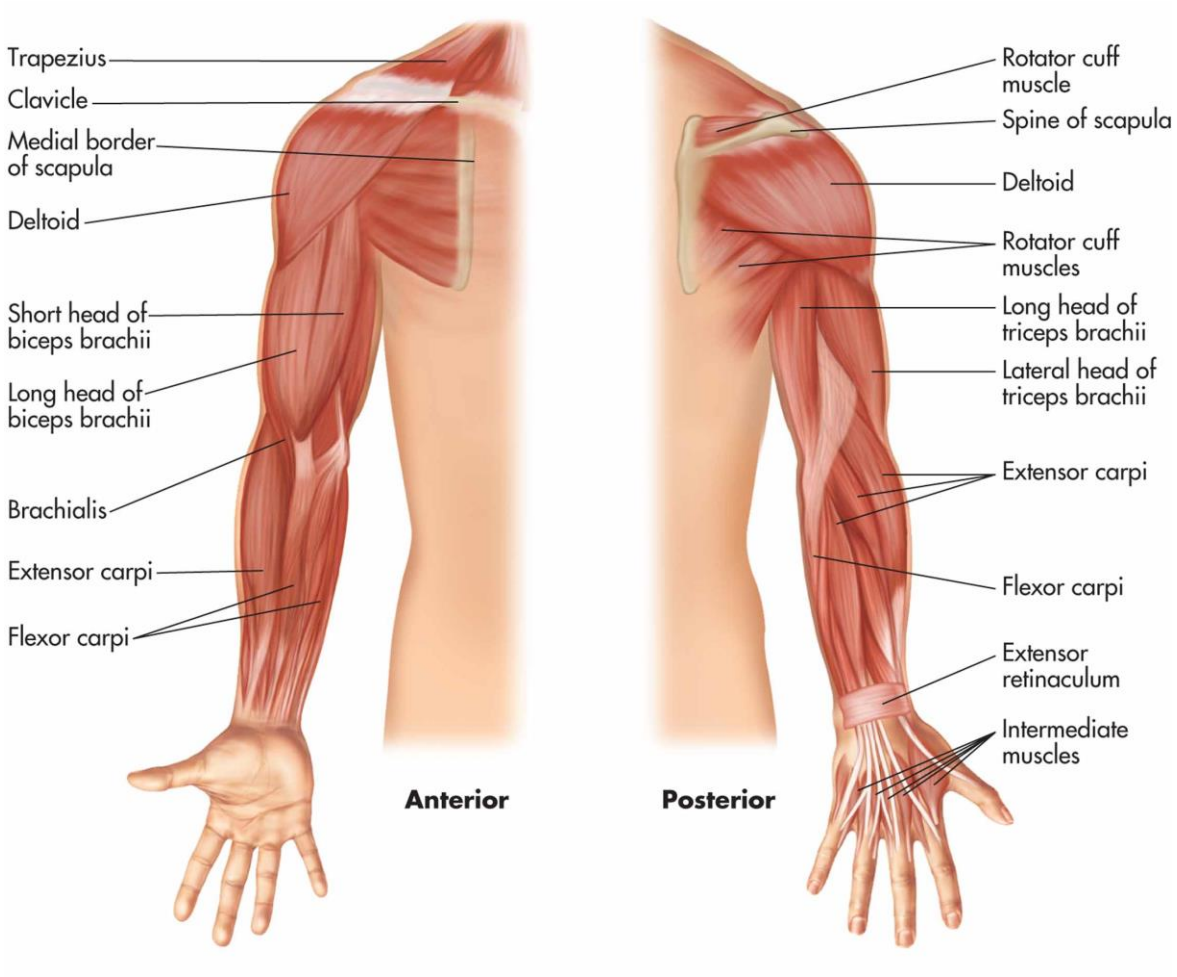
Skeletal Muscles: Facial Muscles



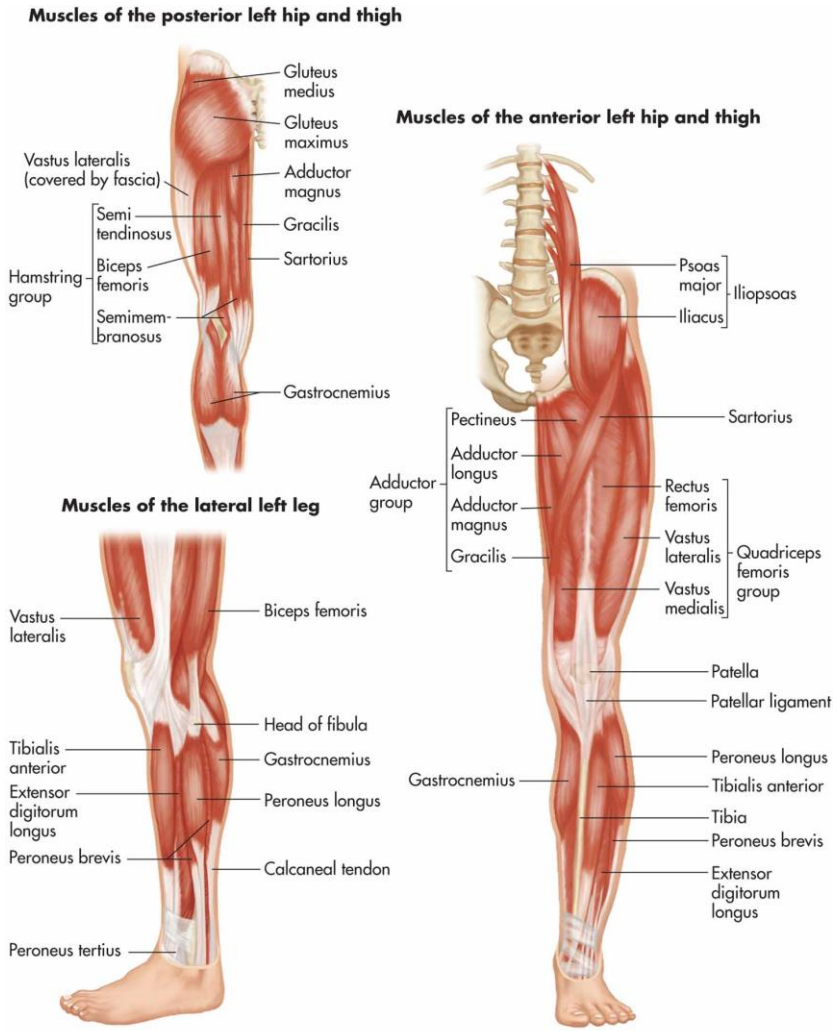
Skeletal Muscles: Trunk



Skeletal Muscles: Shoulders, Arms & Hands



Skeletal Muscles: Hip & Leg



Smooth Muscle

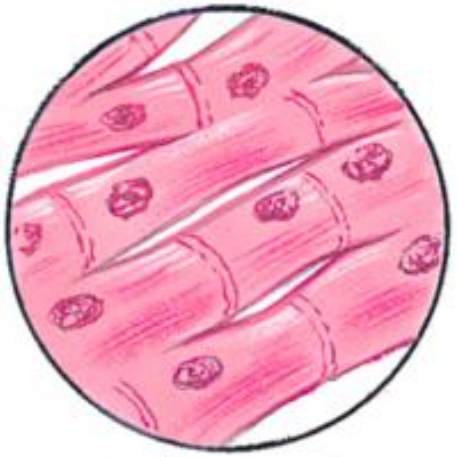
- **Smooth muscles** are also called visceral muscle and are found in hollow organs (except heart) and tubes, such as blood vessels
  - Involuntary muscles; slower than skeletal muscles

- Action
  - **Vasodilation**: Enlarging the diameter of a blood vessel
  - **Vasoconstriction**: Decreasing the diameter of a blood vessel
  - **Sphincters -** close and open tubes


Smooth muscle

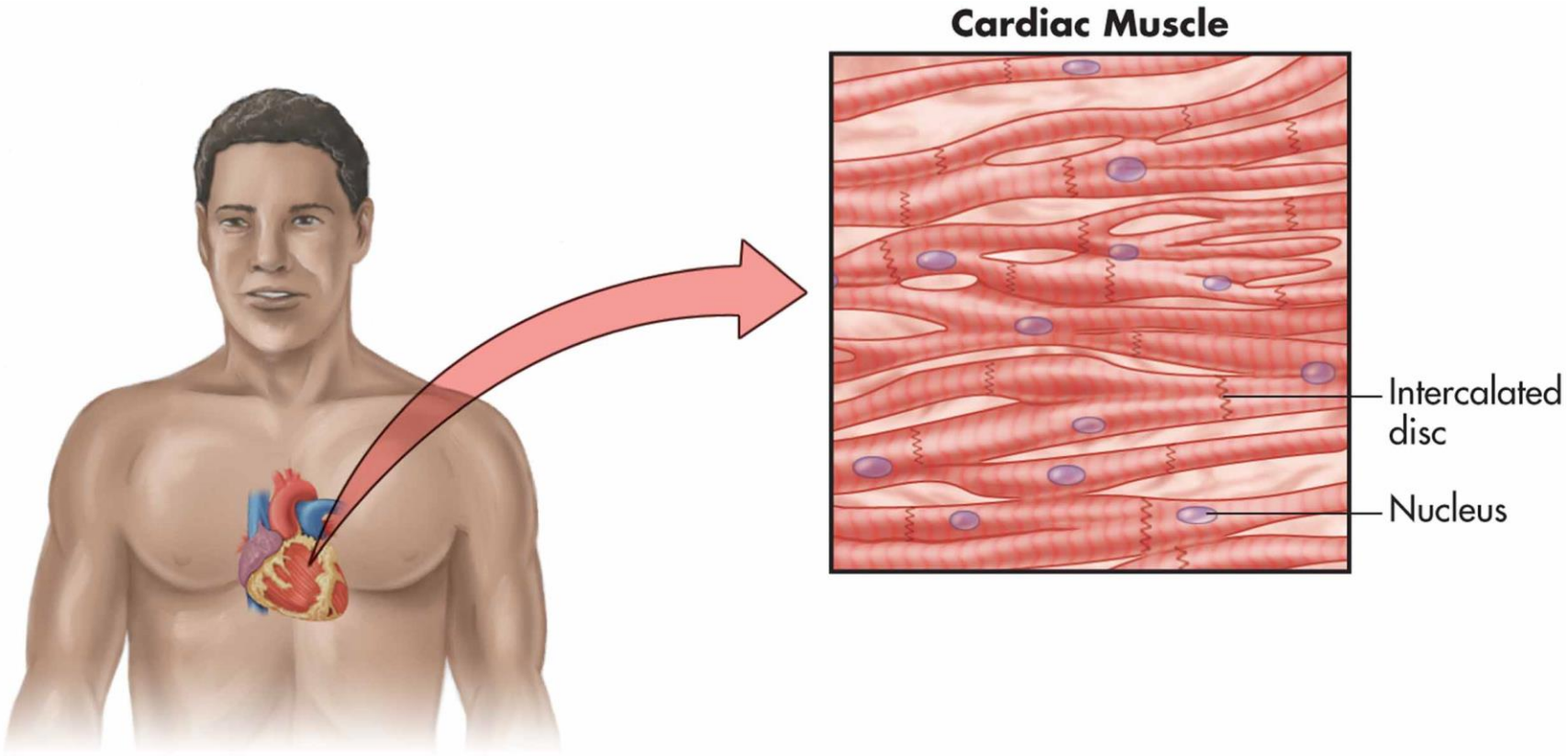
Cardiac Muscle

- **Cardiac muscles are** found in the wall of the heart
  - Involuntary
  - Fibers are shorter and receive a richer supply of blood than any other muscle in the body.
  - Intercalated disks—link fibers; causing one fiber to contract and then pull the next one into a contraction, creating a domino effect
  - Cardiac muscles do not regenerate themselves, leading to scarring.



Cardiac muscle

Cardiac Muscles: Heart and Intercalated Discs



Muscle Tone

- **Tonus** (muscle tone): partial contraction of a muscle with resistance to stretching
- **Hypertrophy:** increased muscle size
- **Atrophy:** muscle wasting from disuse

- Muscles may waste away (atrophy) from lack of use. One of the reasons patients are gotten out of bed as soon as possible is to prevent atrophy from occurring.

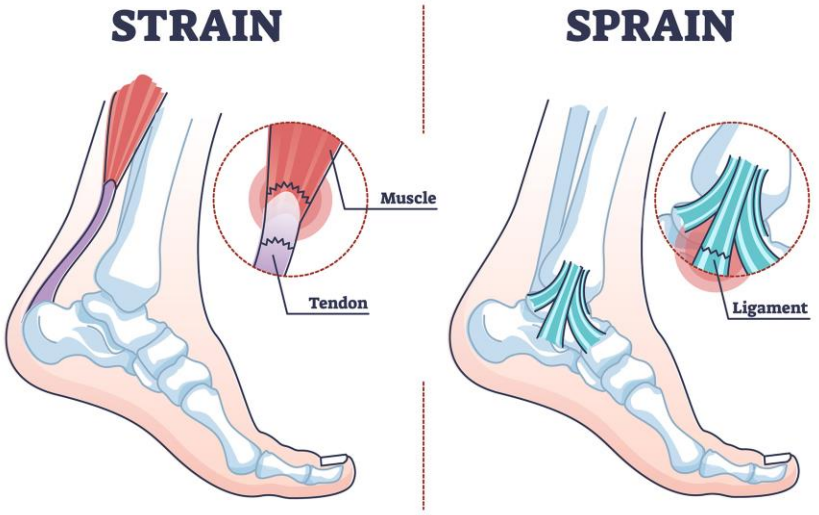
Common Muscular System Disorders

- **Myalgia**: pain or tenderness in a muscle
- **Fibromyalgia**: mainly affects women under 40 but is not fully understood; symptoms include aches, pains, and muscle stiffness with specific tender points; cause is unknown but is linked with chronic fatigue syndrome.
- **Paralysis**: partial or total loss of function in voluntary muscles; can be either flaccid or rigid paralysis

Common Muscular System Disorders

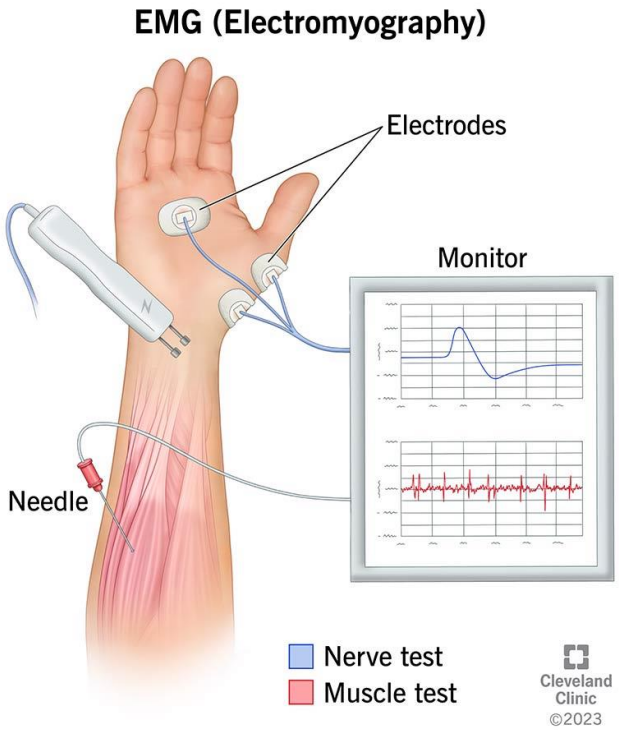
- **Spasm or cramp**: involuntary sudden and violent contraction of a muscle for a prolonged period of time
- **Shin splints**: inflammatory condition of the extensor muscles and surrounding tissues of the lower leg; often found in runners

- **Strains**: actual tears in muscles or tendons
- **Sprains**: tears or breaks in ligaments



Common Muscular System Disorders

- **Hernia**: tear in the muscle wall through which an organ of the body protrudes
- **Tendinitis**: inflammation of tendons
- **Electromyography**: a diagnostic test in which a muscle or group of muscles are stimulated with an electrical impulse, causing contraction, allowing the strength of the contraction to be measured



Common Neuromuscular Disorders

- **Myasthenia Gravis**
  - Gradually increasing profound muscle weakness
  - Drooping eyelid frequently the first symptom
- **Muscular Dystrophy**
  - Inherited muscular diseases
  - Muscle fibers degenerate
  - Progressive muscular weakness occurs
- **Guillain-Barré Syndrome**
  - Disorder of the peripheral nervous system that causes flaccid paralysis and the loss of reflexes
  - Ascends from the feet and progressing to the head
  - Paralysis peaks in 10 to 14 days and then subsides gradually

Common Neuromuscular Disorders

- **Tetanus:** creates rigid paralysis and any minor stimulus causes muscles to go into a major spasm
  - Caused by toxins produced by a bacteria found in the ground and can be spread by any type of puncture, not just a rusty nail
- **Botulism** is a potentially deadly disease resulting from food poisoning with the Clostridium botulinum bacteria.
  - Science can utilize botulinum toxins for medical and cosmetic treatment.
  - Small amounts of botulinus toxin are injected into facial muscles to stop previously untreatable facial twitching by paralyzing the muscles.
  - Toxin also is used to treat wrinkles without surgery; known as Botox injections.