Muscular Tissue

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Muscle Tissue

- Like nervous tissue, muscles are excitable or "irritable" they have the ability to respond to a stimulus
- Unlike nerves, however, muscles are also:
  - **Contractible** (they can shorten in length)
  - **Extensible** (they can extend or stretch)
  - **Elastic** (they can return to their original shape)

Functions of Muscle Tissue

- Muscle makes up a large percentage of the body's weight, Their main functions are to:

  1) **Create motion** – muscles work with nerves, bones, and joints to produce body movements

  2) **Stabilize** body positions and maintain posture

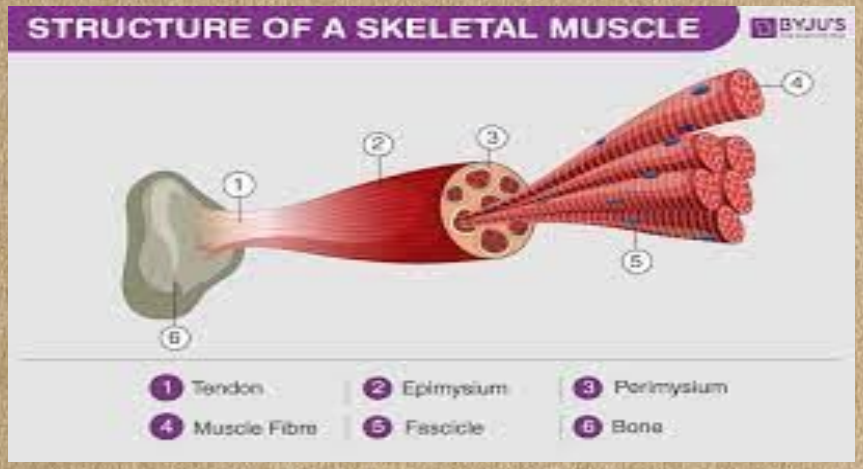
  3) **Store substances** within the body using sphincters (lower esophageal, pyloric & anal)

  4) **Move substances** by peristaltic contractions

  5) **Generate heat** through thermogenesis

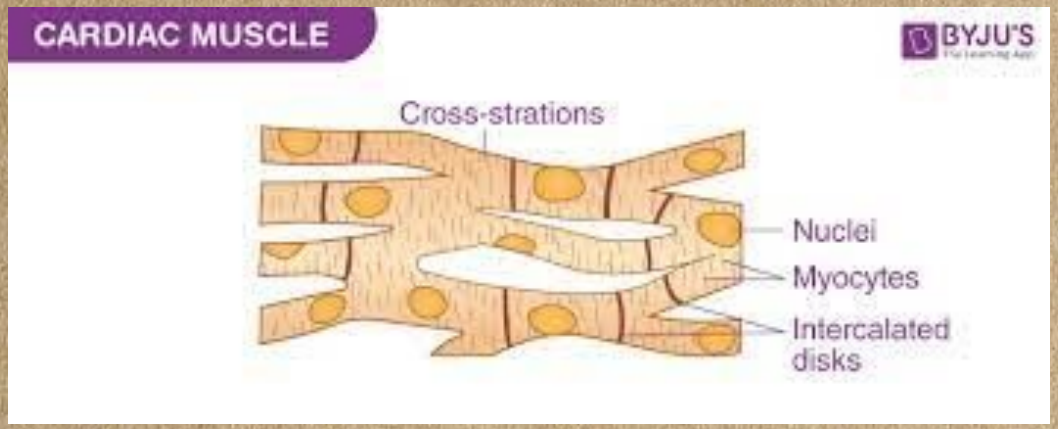
Types of Muscle Tissue

- **Skeletal**
  - Found attached to the skeleton
  - Functions include – movement, heat and posture
  - Striated, multinucleated, fibres parallel
  - Voluntary control



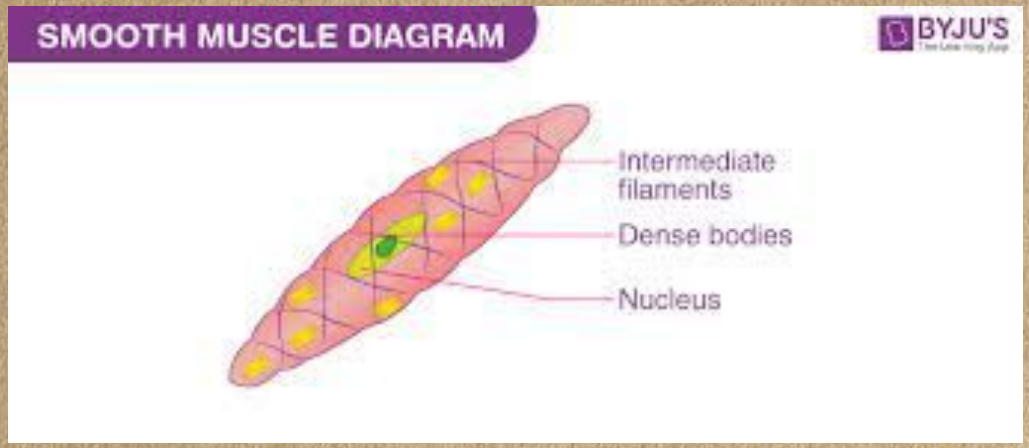
Cardiac Muscle Tissue

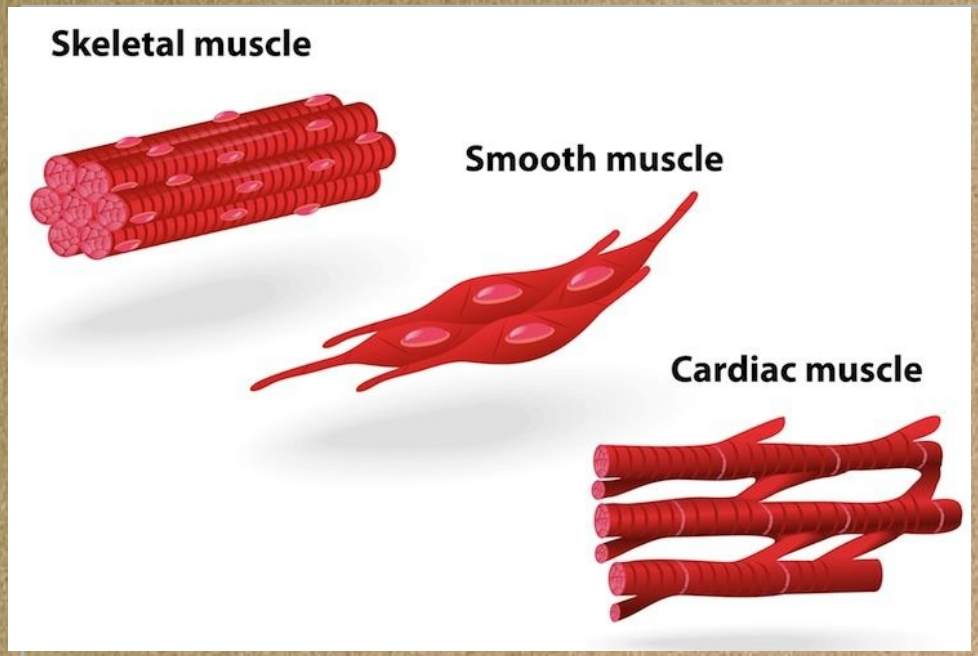
- Located only in the Heart
- Function – Pump blood Continuously
- Striated (stripy), one central nucleus, branched fibers
- Involuntary control

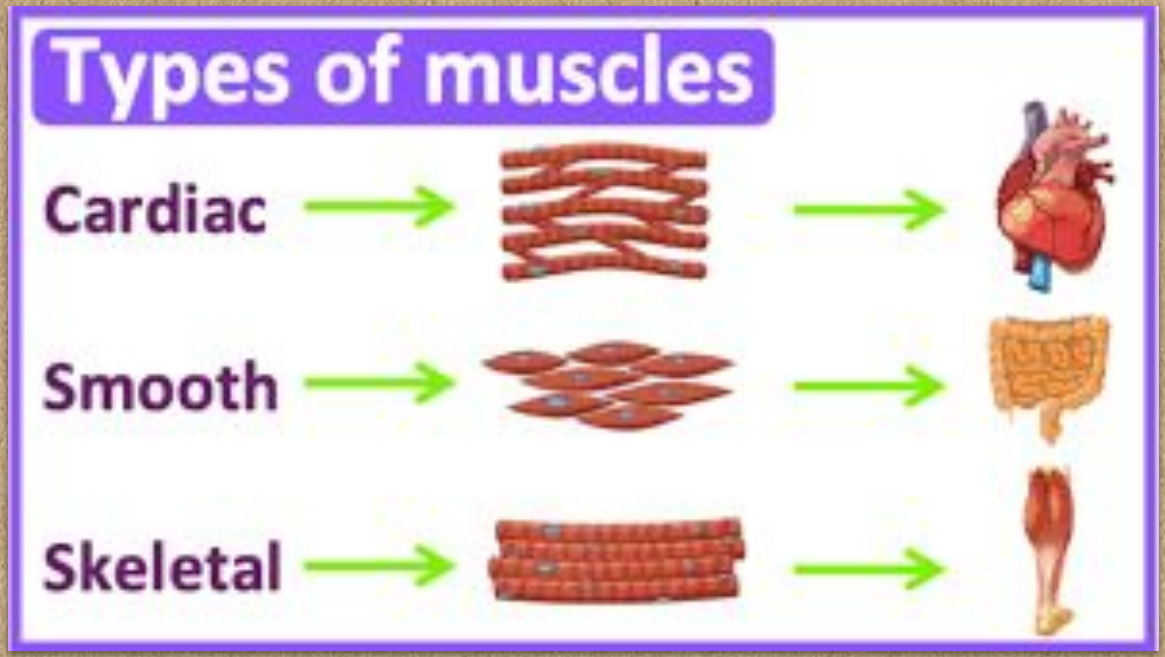


Visceral (Smooth Muscle Tissue)

- GI Tract, Blood vessels, uterus
- Function – Peristalsis, blood pressure
- No Striations, one central nucleus
- Involuntary control




Skeletal muscle
Smooth muscle
Cardiac muscle


Types of muscles
Cardiac
Smooth
Skeletal

Connective Tissue Sheaths

- The epimysium, perimysium, and endomysium all are continuous with the connective tissues that form tendons and ligaments, and muscle fascia (connect muscles to other muscles to form groups of muscles)
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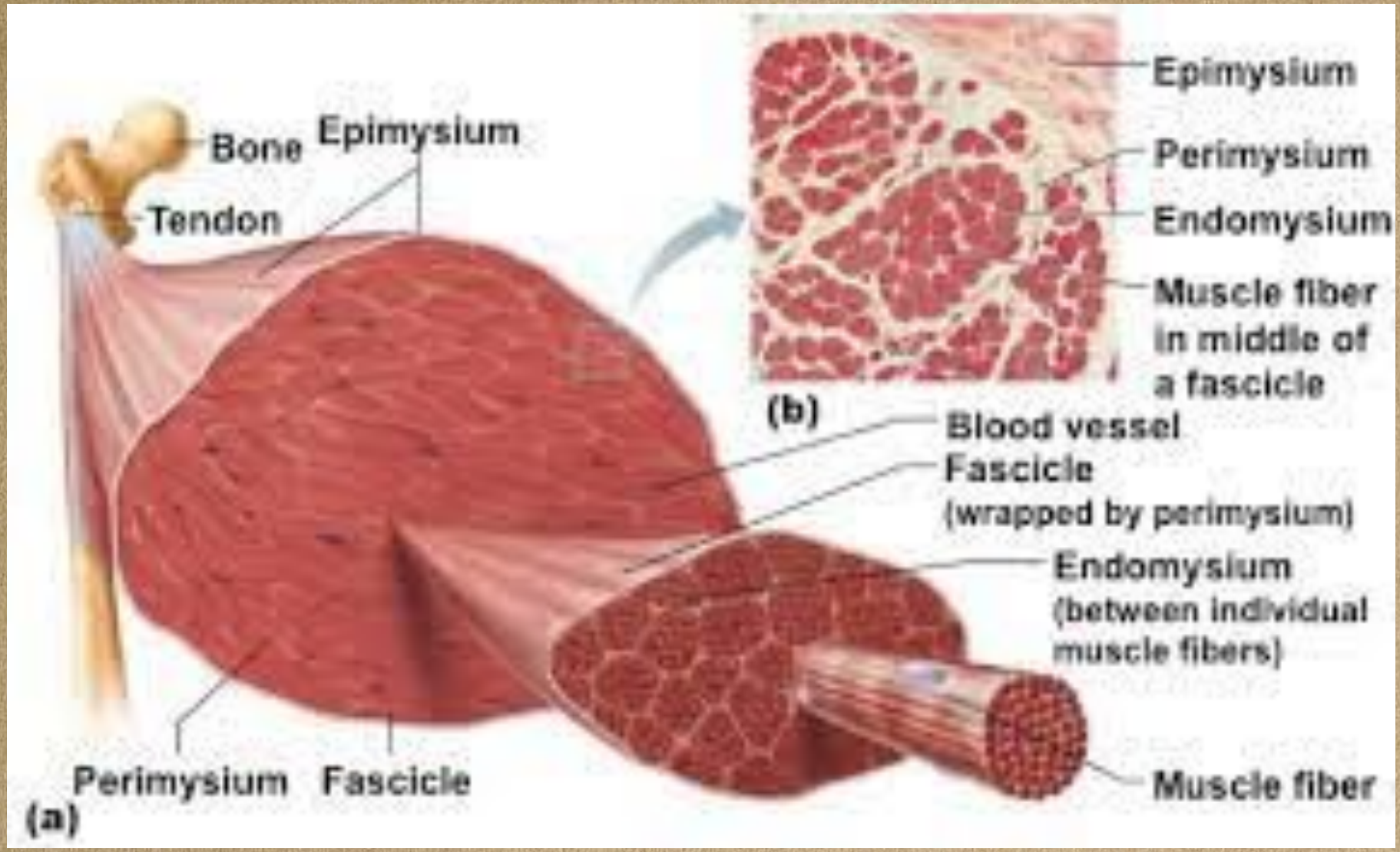
- **Endomysium -** covers each muscle fiber
- **Perimysium -** covers a group of muscle fibers known as a fascicle
- **Epimysium -** covers the entire muscle


Bone
Epimysium
Tendon
Perimysium
Fascicle
(a)
Epimysium
Perimysium
Endomysium
Muscle fiber in middle of a fascicle
(b)
Blood vessel
Fascicle (wrapped by perimysium)
Endomysium (between individual muscle fibers)
Muscle fiber

Fascia

- Connective Tissue that covers the structures of the body.

  <u>Superficial-</u> Lowermost layer of the skin, blending with the reticular dermis. Comprised of **loose areolar CT** that contains many blood vessels and nerves and **adipose tissue.**

  <u>Visceral</u> - The collective term for the connective tissue part of the membranes that surround all of the organs. Includes *pleura of the lung, pericardium of the heart*, *meninges of the brain* and more. It is composed of reticular and elastic connective tissues.

Fascia

Deep - Dense, irregular connective tissue that surrounds the muscle.

Includes the endomysium, perimysium and epimysium.

Includes both blood vessels and sensory receptors.

Functions: - to divide the body into compartments

- to reduce friction of muscular force

- Provide sensory & proprioceptive feedback

Some important deep fascia in the body:

fascia lata that surrounds all the muscles of the thigh & the **brachial fascia** that surrounds the shoulder muscles

Aponeurosis

Thick sheet of fascia that more closely resembles a flattened tendon.

Composed of dense, regular connective tissue that provides a high degree of strength along one axis.

Contain very few blood vessels or nerves.

Have a whitish, silvery appearance.

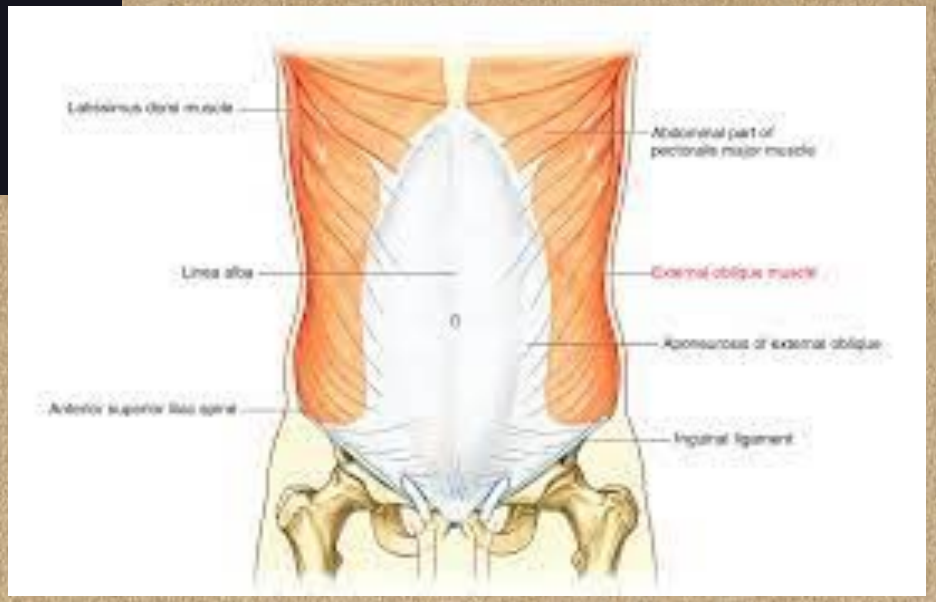
Important aponeuroses:

Abdominal aponeurosis- connects abdominal mms

Palmar & Plantar - Occur on the palms of the hand and soles of feet

Epicranial - Connects occularis mm with frontalis mm on the skull

Aponeurosis



Specialized Terminology Used in Muscle Cells

Muscle cells are also called **myocytes.**

We use the prefix **sarco-** for naming many muscle related things.

Ex. **Sarcolemma-** plasma membrane of a myocyte

Sarcoplasm - cytoplasm of a myocyte

Sarcoplasmic reticulum - the smooth endoplasmic reticulum of a myocyte

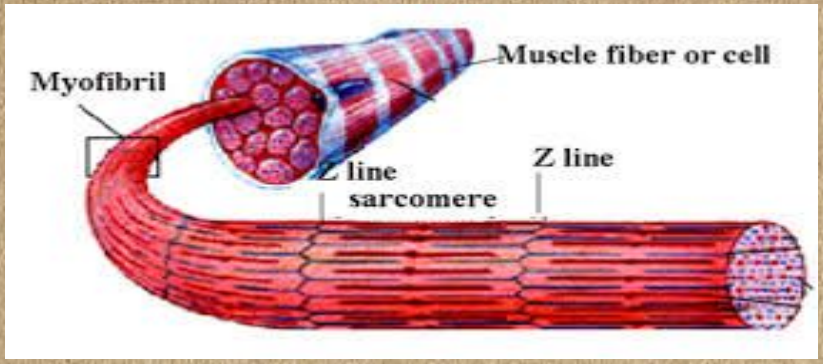
All 3 kinds of muscle cells contain large amounts of the contractile proteins, **actin and myosin.**

Specialized anatomy of the Striated Muscle Cells

Remember: Cardiac and Skeletal muscles are **striated (striped)**

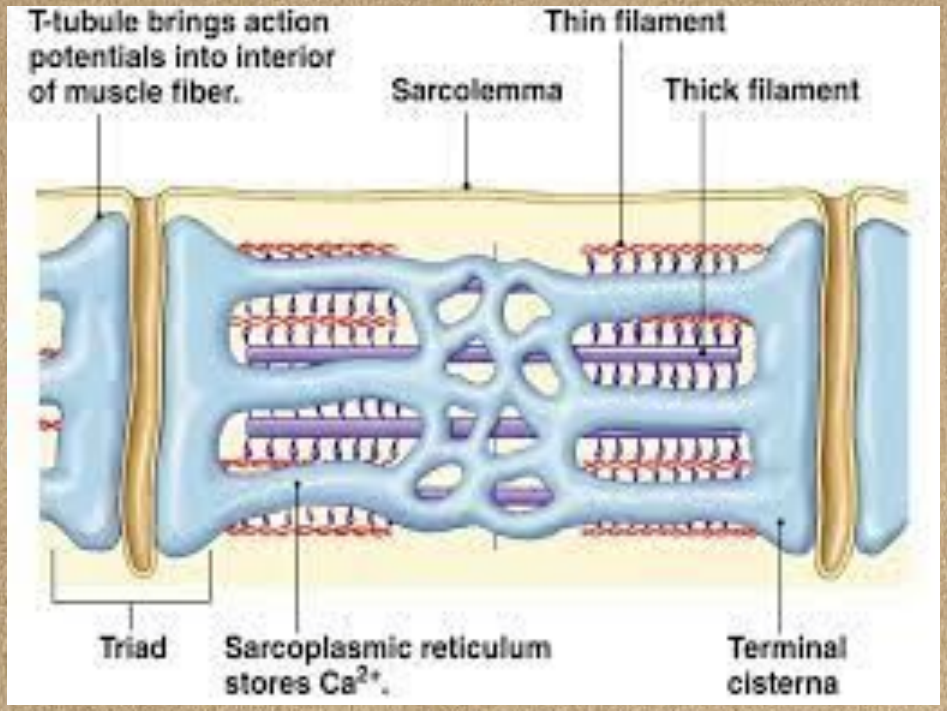
The cells of cardiac muscles are larger than those of smooth muscle cells. The skeletal muscle cells are the largest of all and represent several **myoblasts** fusing together, explaining why skeletal muscle has many nuclei.

The **Striations or stripes** in the muscle, represent these long cells being divided into smaller functional units called **sarcomeres** by zig-zag shaped lines of protein called **z discs.**



Striated Muscles

Cardiac and Skeletal Muscles also contain **T-tubules,** which are the areas where the sarcolemma pinches into the myocytes at the Z discs.



Sarcoplasmic Reticulum & Calcium

The Sarcoplasmic Reticulum is a specialized type of **smooth endoplasmic reticulum** found in muscle cells.

It acts as a reservoir for **Calcium ions,** which are critical in generating a muscle contraction.

After death, the breakdown of the sarcoplasmic reticulum & release of calcium causes **rigor mortis -** the widespread contraction of the muscle tissues that leads to stiffness throughout the body, starting about 2 hours after death & lasting around 36 hours.

Actin & Myosin

Actin and Myosin are the two most common proteins in muscle tissue and are responsible for muscle's **contractile** function.

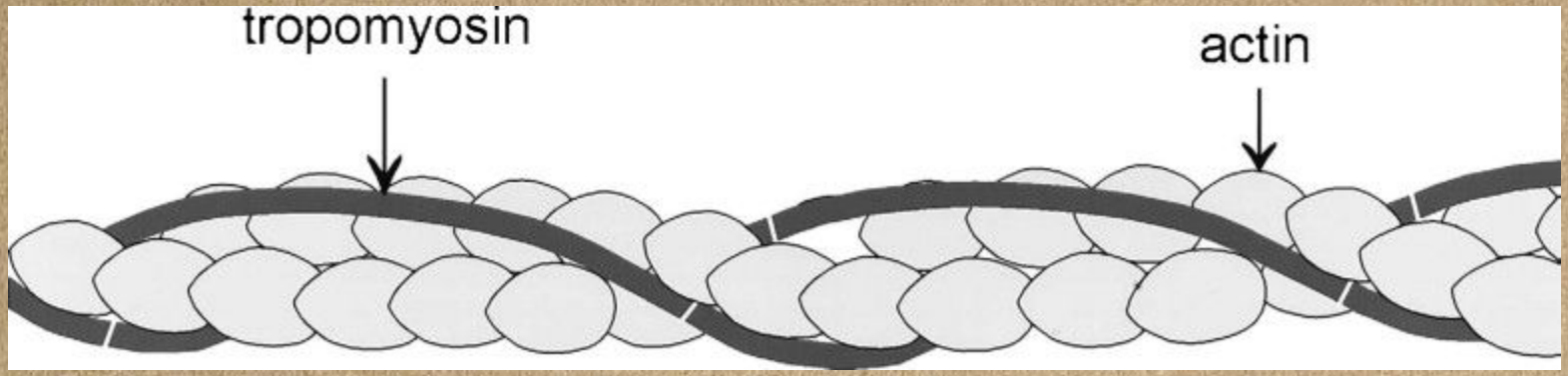
Actin is the main component of the **thin filaments** in myocytes.

Myosin is the main component of the **thick filament** in the myocytes.

In Phys 2, we will learn about the **sliding filament theory** of muscle contraction.

Thin Filament

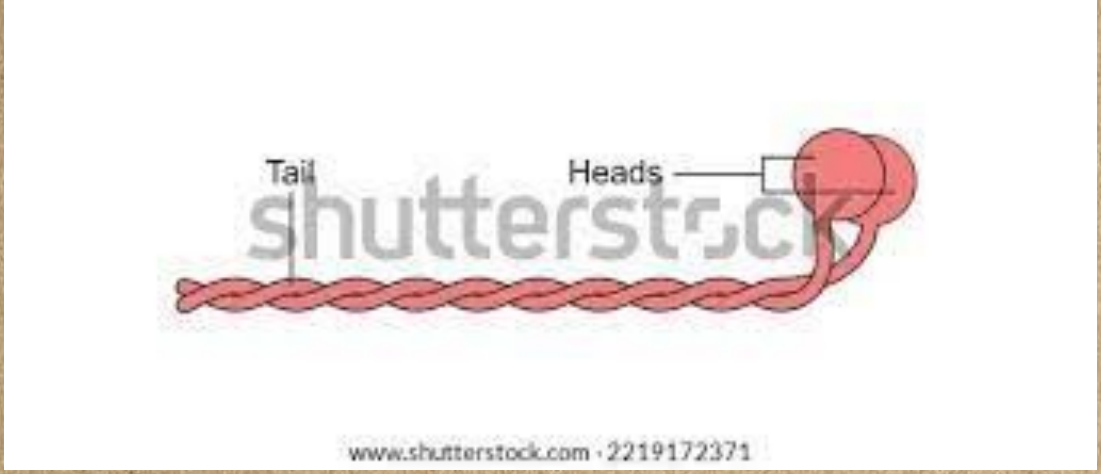
- In the thin filament, actin proteins are bound together like a string of beads or pearls.
- The regulatory proteins, **troponin** and **tropomyosin** are wound around the actin.



Thick Filament

The thick filament is composed mainly of myosin.

It has a structure similar to two golf clubs twisted together, with two exposed myosin “heads”.

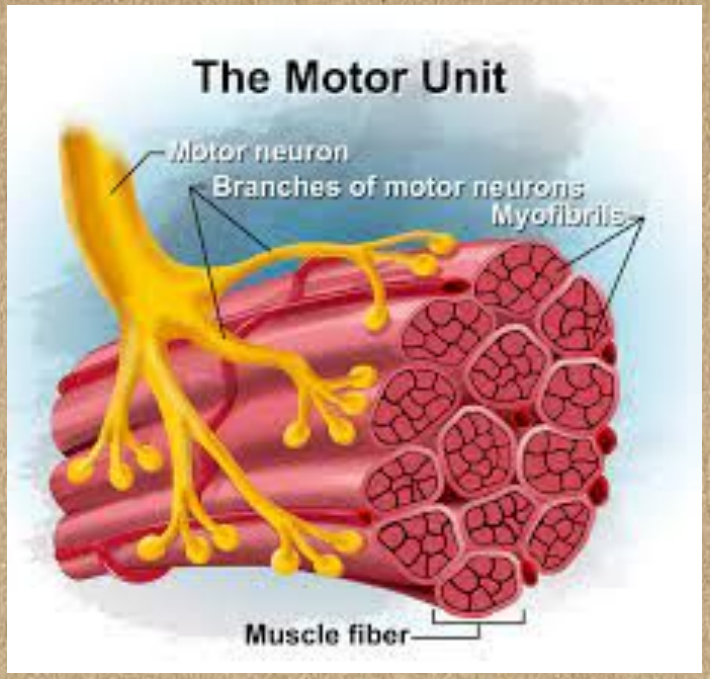


Motor Unit

A motor unit consists of a **motor neuron and all of the muscle fibers that it innervates.**

Small muscles, such as in the eye, will have smaller motor units - about a dozen muscle fibers per motor neuron.

Big muscles, such as the Quadriceps, will have motor units that contain hundreds to thousands of muscle fibers per motor neuron.



Neuromuscular Junction

The Neuromuscular Junction is where the **motor neuron meets the muscle fiber.**

It consists of three parts:

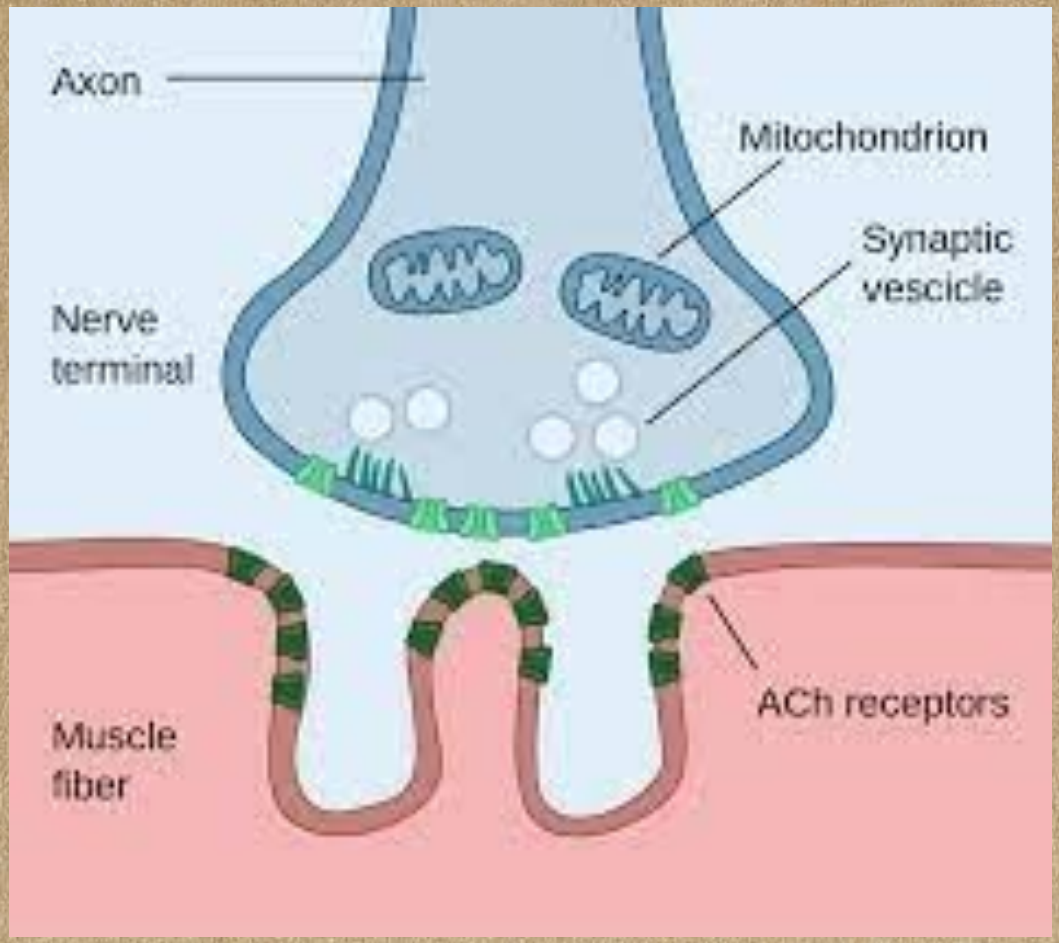
1) The end of the motor neuron or **presynaptic neuron**
2) The **synaptic cleft** which is a small, empty space between the neuron & the muscle fiber
3) The **motor end plate** which is the part of the muscle fiber closest to the nerve ending. It is considered **postsynaptic** (after the synapse)

Neuromuscular Junction

1) Presynaptic Motor Neuron

2) Synaptic cleft

3) Motor End-Plate Of the Post synaptic Muscle fiber

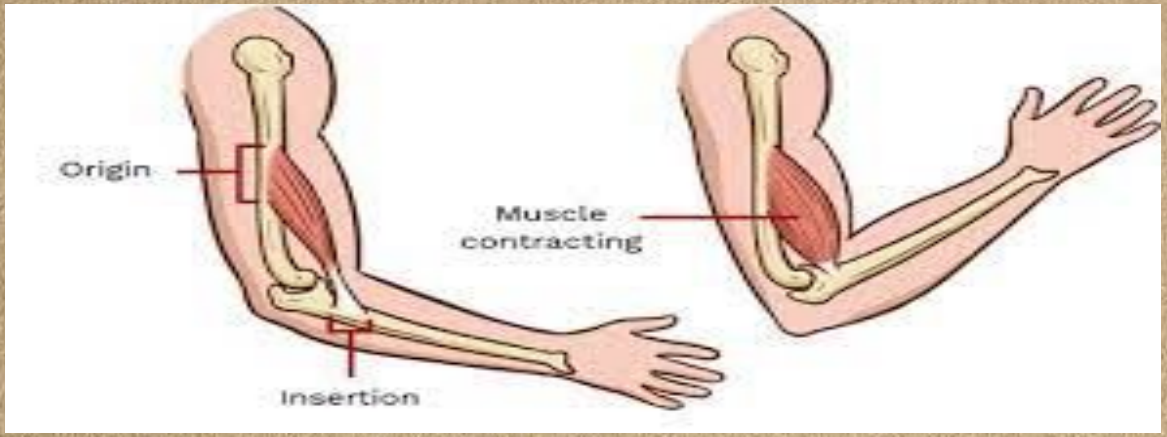


Imbalances in homeostasis

- **Exercise-induced muscle damage**
  - After intense exercise electron micrographs reveal considerable muscle damage including torn sarcolemmas and disrupted Z-discs
  - Blood levels of proteins normally confined only to muscle (including myoglobin and the enzyme creatine kinase) increase as they are released from damaged muscle
- **Spasm**
  - A sudden involuntary contraction of a single muscle within a large group of muscles – usually **painless**
- **Cramp**
  - Involuntary and often **painful** muscle contractions
  - Caused by inadequate blood flow to muscles (such as in dehydration), overuse and injury, and abnormal blood electrolyte levels

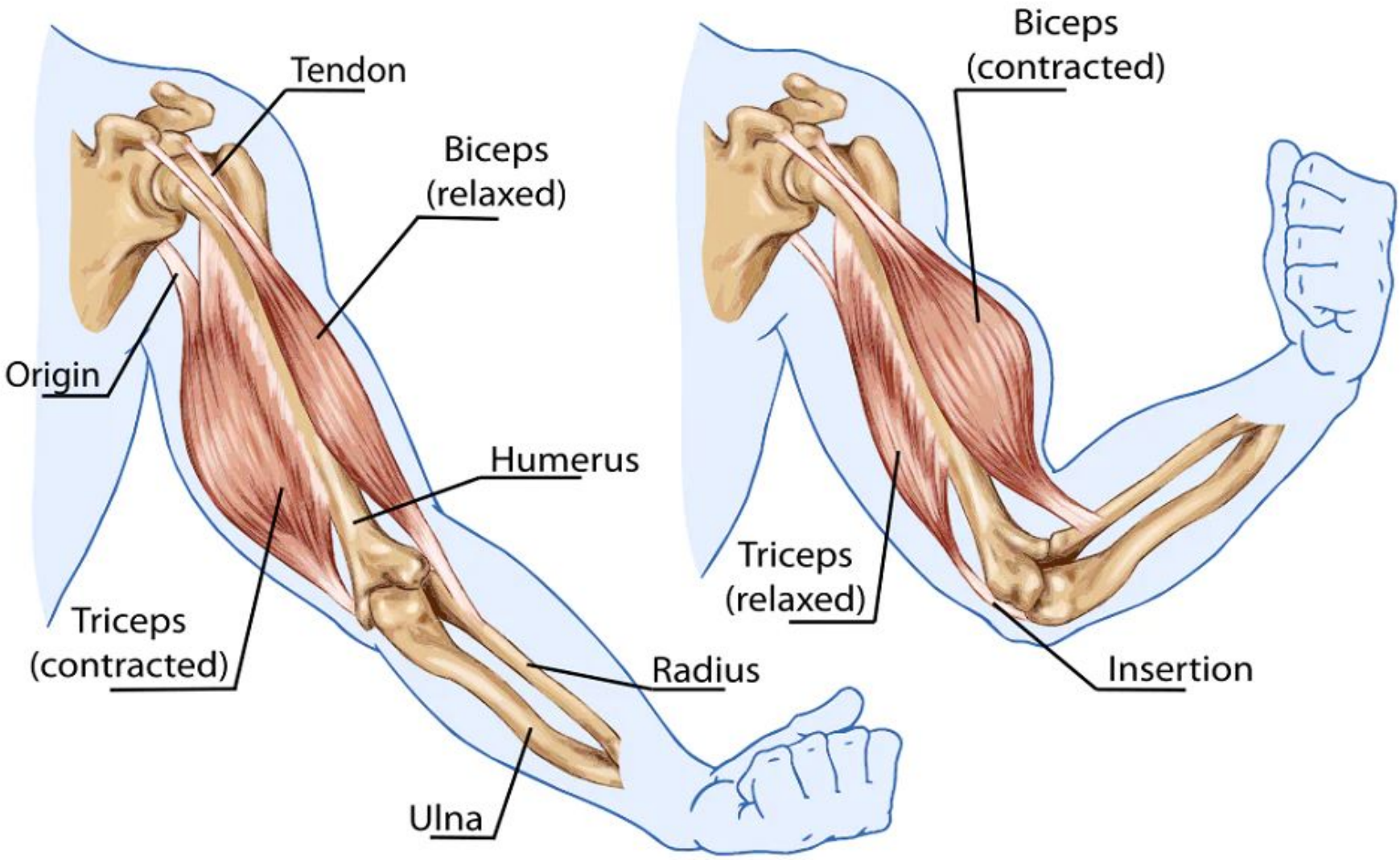
Muscle Origins and Insertions

- The **origin** of a muscle is where the muscle is attached to bone, but does not move.
- It is usually the part of the muscle most **proximal** (close) to the torso of the body.
- The **Insertion** is the site where bone and muscle ar attached and movement occurs. Usually the part of the muscle most **distal** to the torso.



Muscle movements

- Movements are often the result of several skeletal muscles acting as a group. Most skeletal muscles are arranged in **antagonistic** (opposing) pairs at joints.
- Within opposing pairs, the **prime mover or agonist** ("the leader") is the muscle primarily responsible for causing the desired movement.
- The **antagonist** stretches and yields to the effects of the prime mover.
- Eg. flexing the forearm at the elbow, the biceps brachii is the prime mover or agonist, and the triceps brachii is the antagonist


Tendon
Biceps
(relaxed)
Origin
Humerus
Triceps
(contracted)
Radius
Ulna
Biceps
(contracted)
Triceps
(relaxed)
Insertion