

Characteristics of Muscle

- Responsiveness (Excitability)—To chemical signals, stretch, and electrical changes across the plasma membrane
- Conductivity—Local electrical charge triggers a wave of excitation that travels along the muscle fiber
- Contractility—Shortens when stimulated
- Extensibility—Capable of being stretched between contractions
- Elasticity—Returns to its original resting length after being stretched

Structure of Muscle Fiber

- Epimysium: Connective tissue that covers entire muscle
- Perimysium: Connective tissue around muscle fascicles
 - Fascicles: Surrounded by perimysium
- Endomysium: Connective tissue around muscle cells
 - Continuous with collagen fibers of tendons and connective tissue of bone matrix
 - Collagen—Somewhat extensible and elastic (stretches slightly under tension and recoils when released)
 - Resists excessive stretching and protects muscle from injury
 - Returns muscle to its resting length
 - Contribute to power output and muscle efficiency
- Muscle Fibers (Cells): Surrounded by endomysium
- Myofibrils
- Myofilaments: Thick and thin filaments

Skeletal Muscle: Voluntary, striated muscle attached to one or more bones

- Multinucleated
- Striated: Alternating light and dark transverse bands as a result of overlapping of internal contractile proteins
- Voluntary: Usually subject to conscious control

Muscle Fiber (Muscle Cell)

- Sarcolemma: Plasma membrane of muscle cell
- Sarcoplasm: Cytoplasm of a muscle fiber
- Myofibrils: Long protein bundles that occupy the main portion of the sarcoplasm

- Glycogen: Storage form of glucose in abundance to provide energy with heightened exercise
 - Ready for action
- Myoglobin: Red pigment that carries oxygen needed for muscle activity
 - Equivalent of hemoglobin in muscle cells
- Multiple Nuclei—Flattened nuclei pressed against the inside of the sarcolemma
 - Myoblasts: Stem cells that fuse together to form each muscle fiber
 - Satellite Cells: Unspecialized myoblasts remaining between the muscle fiber and endomysium that are important for muscle repair
 - May multiply and produce new muscle fibers to some degree
- Repair by fibrosis (scar formation) rather than regeneration of functional muscle
- Mitochondria: Packed in spaces between myofibrils
 - Very active so need a lot of these
- Sarcoplasmic Reticulum (SR): Smooth endoplasmic reticulum of muscle cells that forms a network around each myofibril ****Calcium reservoir****
 - Calcium activates the muscle contraction process
- Terminal Cisternae: Dilated end-sacs of SR which cross muscle fiber from one side to the other
- Transverse Tubules (T-Tubules): Tubular infoldings of the sarcolemma which penetrate through the cell and emerge on the other side
- Triad: 2 Terminal Cisternae + 1 T-Tubule

Myofibril: Bundle of parallel myofilaments

- Myosin: Thick filament basic molecule
 - Several myosin molecules bond together to form a thick filament
 - Looks like two golf clubs intertwined
 - Myosin Head: Sticks off of thick filament
- Actin: Thin filament basic molecule

- Thin filaments consist of two intertwined strands of fibrous actin (F-actin)
- String of globular actin (G-actin)
 - Think of two curly hairs wound together --> Each strand = Individual curl
- Thin filaments associated with regulatory proteins—tropomyosin and troponin
 - Contractile Proteins: Do work
 - Tropomyosin: Covers the myosin binding sites on each actin bead
 - Troponin: Located on myosin binding site when muscle is relaxed
 - When calcium is released, it binds to troponin and causes a shift in the tropomyosin complex that causes it to roll away
 - Calcium is KEY—Makes binding sites free and no longer covered by tropomyosin complex
 - Not everywhere on tropomyosin, just a few spots
- **Think gate at front of mansion to regulate who comes in—Regulatory proteins guard actin and myosin to let them know when to contract
- Titin (Connectin): Elastic filament that anchors myosin to Z disc
 - Think of springs/slinky—Only let muscles stretch a certain amount

Sarcomere

- Two Z discs at ends—Distance between them decreases when muscle contracts
- Anisotropic Band (A-Band): Full length of myosin filament
 - Find thick, thin and elastic filament
 - Stays the same during muscle contraction
- H-Band: Middle of A-Band
 - Find thick filament and elastic filament
 - Shortens during muscle contraction
- M-Line: Complex proteins that bisect the H-Band to provide structural support
- I-Band: Next to Z disc on both sides