

Skeletal Muscle Tissue

Chapter 10

Introduction

- Muscles are responsible for movement
 - Contraction & relaxation
- Muscles make up 40 – 50 % of a human's total body weight

Characteristics of Muscle Tissue

- **Excitability**
 - Can receive & respond to **stimuli**
- **Contractility**
 - Can shorten & thicken
- **Extensibility**
 - Can be stretched
- **Elasticity**
 - Can return to its original shape

Functions of Muscle Tissue

- Motion
- Maintenance of posture
- Heat production

Kinds of Muscle Tissue

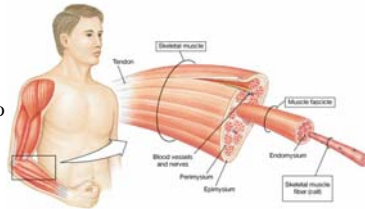
- **Skeletal Muscle**
- **Cardiac Muscle**
- **Smooth Muscle**

The Muscular System

- Muscle tissue = all contractile tissue
- Muscular system =
 - Skeletal muscle tissue
 - Connective tissue

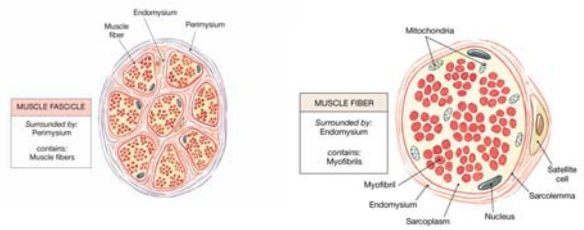
Fascia of Skeletal Muscle

- **Epimysium**
 - Wraps muscle
- **Perimysium**
 - Divides muscle into **bundles (fasciculi)**
- **Endomysium**
 - Separates each muscle cell



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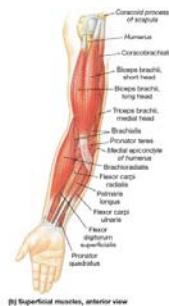
Fascia of Skeletal Muscle



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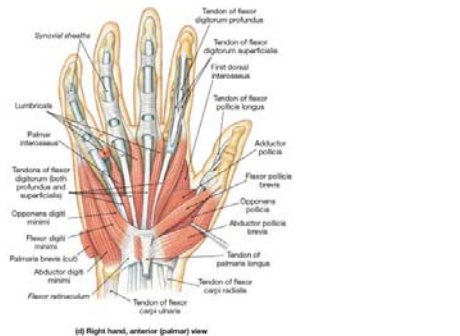
Tendons & Aponeuroses

- Epimysium
- Perimysium
- Endomysium



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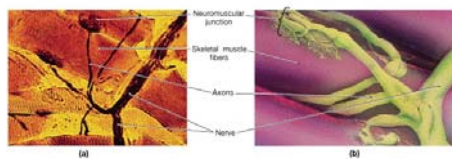
Tendon Sheaths



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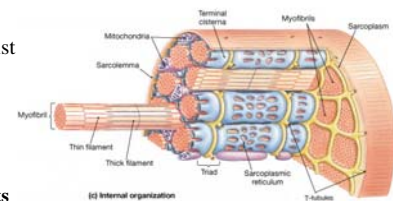
Nerve & Blood Supply

- Related to contraction
- Artery and 1 or 2 veins accompany each nerve
 - Each muscle cell is in contact with **capillaries**
- Each muscle cell is in contact with a portion of a nerve cell
 - **Neuromuscular junction**



Histology of Skeletal Muscle Tissue

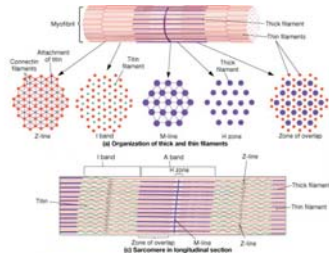
- **Muscle fibers** = elongated cells
 - **Sarcolemma**
 - **Sarcoplasm**
 - **Sarcoplasmic reticulum**
 - **T tubules**
 - **Triad**
- Muscle fibers consist of **myofibrils**
 - Extend length of fiber
- Myofibrils consist of **myofilaments**
 - **Thin filaments**
 - **Thick filaments**



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Myofilaments

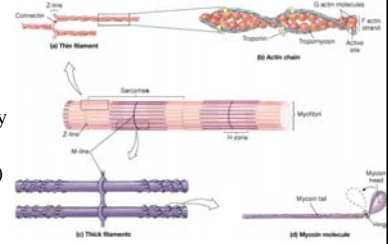
- Myofilaments do not extend entire length of fiber.
- Stacked in compartments = **sarcomeres**
 - Partitioned by **Z lines**
 - **A band** (dark) – contains thick filaments
 - Includes **H zone, zone of overlap**
 - **I band** (light) – thin filaments only
 - **H zone** – thick filaments only



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Myofilaments

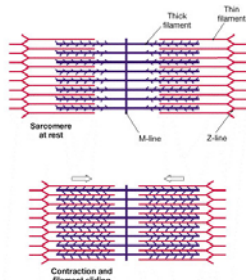
- Thin filaments
 - Composed mostly of **actin**
 - Contain **tropomyosin** and **troponin**
 - Double-stranded coil
- Thick filaments
 - Composed mostly of **myosin**
 - Rod-shaped (**tail**) with **head**



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Contraction – Sliding Filament Theory

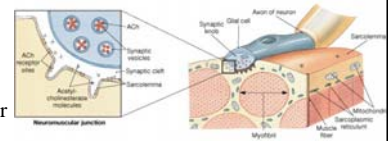
- Thin filaments slide inward toward the H zone
 - Z lines are drawn toward the A band
- Sarcomere shortens
- Lengths of myofilaments do not change
- **Cross bridges** of thick filaments connect with actin
- Width of the H zone gets smaller



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Neuromuscular Junction

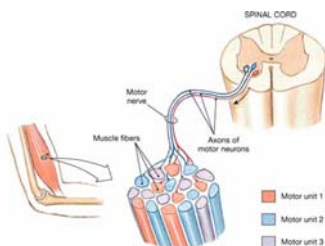
- Contraction requires a stimulus
- An **axon** comes into close contact with a muscle membrane
 - **Motor end plate**
- **Acetylcholine** transmits **nerve impulse** to the motor end plate
 - Initiates contraction
- **Axon terminal + motor end plate = neuromuscular junction**



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Motor Unit

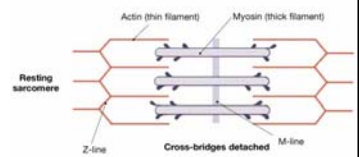
- Def. – **motor neuron** and all muscle cells it stimulates
- 1 motor neuron may **innervate** few or many muscle cells
- The number of muscle fibers/motor unit determines how precise a movement is.



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Physiology of Contraction – Relaxed Muscle

- Sarcoplasm is low in **calcium**
- ATP is bound to myosin cross bridges
- **Tropomyosin-troponin complex** is attached to actin



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Physiology of Contraction – Stimulation of Muscle

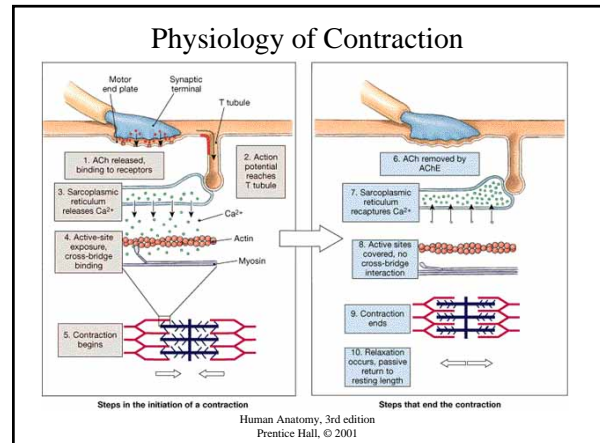
- Nerve impulse reaches motor end plate
- Neuron releases ACh
- Electrical charge travels along sarcolemma
- Electrical charge travels down T tubules
- Electrical charge travels to S.R.
- S.R. releases calcium into sarcoplasm

Physiology of Contraction – Activation of Myosin

- Calcium binds to troponin
- Cross bridges form
- Calcium acts as an enzyme
 - Breaks down **ATP to ADP + P**
- Myosin cross bridges move
- Sarcomere shortens
- Muscle shortens

Physiology of Contraction – Relaxation of Muscle

- Nerve impulse ends
- ACh is broken down by **acetylcholinesterase**
- Calcium is actively transported back into S.R.
 - $ADP + P = ATP$
 - Binds to cross bridges
- Myosin cross bridges separate from actin
- **Binding sites** on actin are covered
- Thin myofilaments slip back to resting position
- Sarcomeres return to resting length
- Muscle fiber returns to resting length



Fast, Slow, and Intermediate Muscles

- Duration of contraction varies with function
- **Fast muscles** (white)
 - More extensive SR
 - Lack **myoglobin**
 - Fewer capillaries
- **Slow muscles** (red)
 - Smaller fibers
 - More capillaries
 - Lots of myoglobin

Disorders

- **Fibrosis**
- **Fibrositis**
- **Fibromyalgia**
- **Muscular dystrophy**
- **Myasthenia gravis**

Classifications in the Muscular System

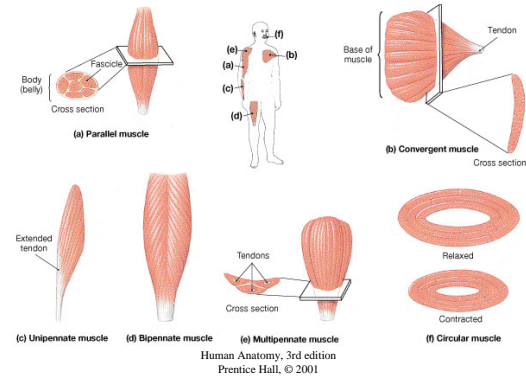
How Skeletal Muscles Produce Movement

- Exert force on tendons
- Attached to articulating bones forming a joint
- When muscle contracts, one bone moves toward the other
- Attachments
 - **Origin** = attachment to stationary bone
 - **Insertion** = attachment to moveable bone
 - **Belly** = fleshy portion of muscle between tendons

Arrangement of Fasciculi

- **Parallel**
- **Convergent**
- **Pennate**
 - Unipennate
 - Bipennate
 - Multipennate
- **Circular**
- Arrangement is correlated with the power and range of movement of a muscle.

Arrangement of Fasciculi



Group Actions

- **Agonist** or **prime mover**
 - Causes desired action
- **Antagonist**
 - Effect is opposite to agonist
- **Synergist** or **fixator**
 - Assists agonist

Naming of Skeletal Muscles

- Direction of muscle fibers
- Location
- Size
- Number of origins
- Shape
- Origin & insertion
- Action