

Muscle Lecture for Anatomy

Bio 250

The Muscular System

- Muscles are responsible for all types of body movement
- Three basic muscle types are found in the body
 - Skeletal muscle
 - Cardiac muscle
 - Smooth muscle

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Slide 6.1

Characteristics of Muscles

- Muscle cells are elongated (muscle cell = muscle fiber)
- Contraction of muscles is due to the movement of microfilaments
- All muscles share some terminology
 - Prefix *myo* refers to muscle
 - Prefix *mys* refers to muscle
 - Prefix *sarco* refers to flesh

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Slide 6.2

Skeletal Muscle Characteristics

- Most are attached by tendons to bones
- Cells are multinucleate
- Striated – have visible banding
- Voluntary – subject to conscious control
- Cells are surrounded and bundled by connective tissue

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Slide 6.3

Connective Tissue Wrappings of Skeletal Muscle

- Endomysium – around single muscle fiber
- Perimysium – around a fascicle (bundle) of fibers

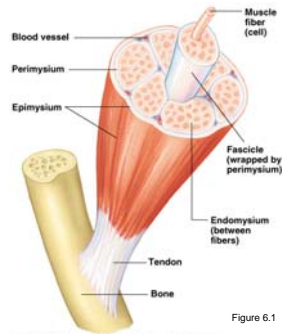


Figure 6.1

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Slide 6.4a

Connective Tissue Wrappings of Skeletal Muscle

- Epimysium – covers the entire skeletal muscle
- Fascia – on the outside of the epimysium

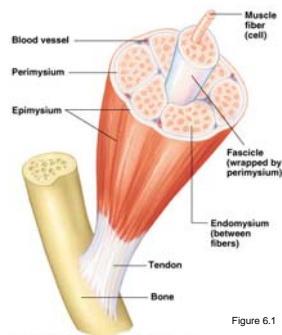


Figure 6.1

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Skeletal Muscle Attachments

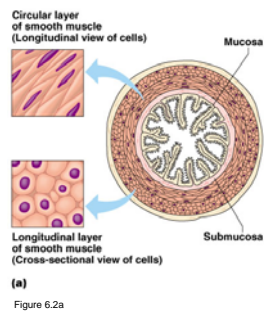
- Epimysium blends into a connective tissue attachment
 - Tendon – cord-like structure
 - Aponeuroses – sheet-like structure
- Sites of muscle attachment
 - Bones
 - Cartilages
 - Connective tissue coverings

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Smooth Muscle Characteristics

- Has no striations
- Spindle-shaped cells
- Single nucleus
- Involuntary – no conscious control
- Found mainly in the walls of hollow organs

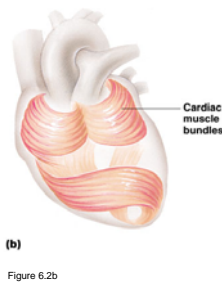


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Cardiac Muscle Characteristics

- Has striations
- Usually has a single nucleus
- Joined to another muscle cell at an intercalated disc
- Involuntary
- Found only in the heart



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Function of Muscles

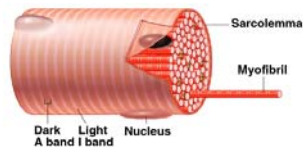
- Produce movement
- Maintain posture
- Stabilize joints
- Generate heat

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Microscopic Anatomy of Skeletal Muscle

- Cells are multinucleate
- Nuclei are just beneath the sarcolemma



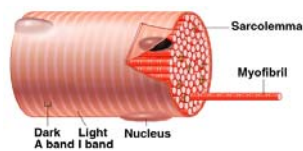
(a) Segment of a muscle fiber (cell) Figure 6.3a

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Slide 6.9a

Microscopic Anatomy of Skeletal Muscle

- Sarcolemma – specialized plasma membrane
- Sarcoplasmic reticulum – specialized smooth endoplasmic reticulum



(a) Segment of a muscle fiber (cell) Figure 6.3a

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Slide 6.9b

Microscopic Anatomy of Skeletal Muscle

- Myofibril
 - Bundles of myofilaments
 - Myofibrils are aligned to give distinct bands
 - I band = light band
 - A band = dark band

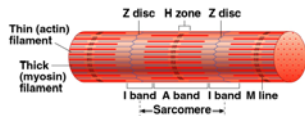


Figure 6.3b (b) Myofibril or fibril (complex organelle composed of bundles of myofilaments)

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Slide 6.10a

Microscopic Anatomy of Skeletal Muscle

- Sarcomere
 - Contractile unit of a muscle fiber

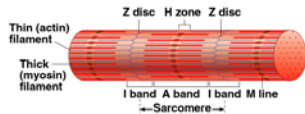


Figure 6.3b (b) Myofibril or fibril (complex organelle composed of bundles of myofilaments)

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Slide 6.10b

Microscopic Anatomy of Skeletal Muscle

- Organization of the sarcomere
 - Thick filaments = myosin filaments
 - Composed of the protein myosin
 - Has ATPase enzymes

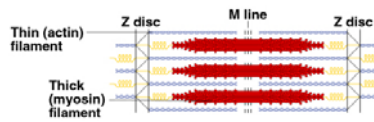


Figure 6.3c (c) Sarcomere (segment of a myofibril)

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Microscopic Anatomy of Skeletal Muscle

- Organization of the sarcomere
 - Thin filaments = actin filaments
 - Composed of the protein actin

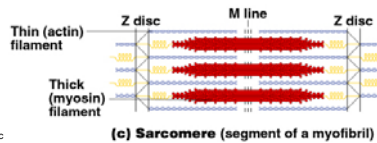


Figure 6.3c

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Microscopic Anatomy of Skeletal Muscle

- Myosin filaments have heads (extensions, or cross bridges)
- Myosin and actin overlap somewhat

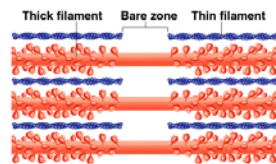


Figure 6.3d

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Microscopic Anatomy of Skeletal Muscle

- At rest, there is a bare zone that lacks actin filaments
- Sarcoplasmic reticulum (SR) – for storage of calcium

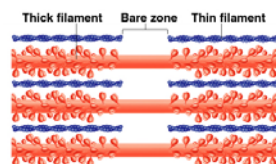


Figure 6.3d

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Properties of Skeletal Muscle Activity

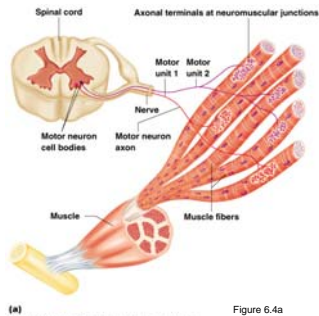
- Irritability – ability to receive and respond to a stimulus
- Contractility – ability to shorten when an adequate stimulus is received

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Nerve Stimulus to Muscles

- Skeletal muscles must be stimulated by a nerve to contract
- Motor unit
 - One neuron
 - Muscle cells stimulated by that neuron

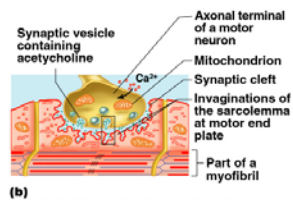


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Nerve Stimulus to Muscles

- Neuromuscular junctions – association site of nerve and muscle



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Nerve Stimulus to Muscles

- Synaptic cleft – gap between nerve and muscle
 - Nerve and muscle do not make contact
 - Area between nerve and muscle is filled with interstitial fluid

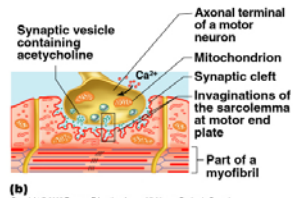


Figure 6.5b

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Slide
6.15b

Transmission of Nerve Impulse to Muscle

- Neurotransmitter – chemical released by nerve upon arrival of nerve impulse
 - The neurotransmitter for skeletal muscle is acetylcholine
- Neurotransmitter attaches to receptors on the sarcolemma
- Sarcolemma becomes permeable to sodium (Na^+)

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Slide
6.16a

Transmission of Nerve Impulse to Muscle

- Sodium rushing into the cell generates an action potential
- Once started, muscle contraction cannot be stopped

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6.16b

The Sliding Filament Theory of Muscle Contraction

- Activation by nerve causes myosin heads (crossbridges) to attach to binding sites on the thin filament
- Myosin heads then bind to the next site of the thin filament

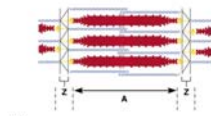
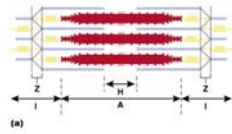


Figure 6.7

Slide 6.17a

The Sliding Filament Theory of Muscle Contraction

- This continued action causes a sliding of the myosin along the actin
- The result is that the muscle is shortened (contracted)

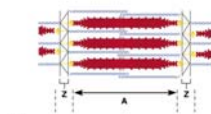
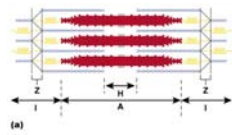


Figure 6.7

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Muscles and Body Movements

- Movement is attained due to a muscle moving an attached bone

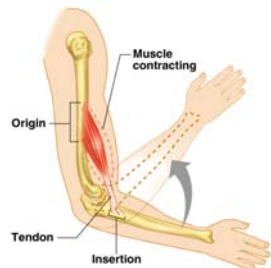


Figure 6.12

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Muscles and Body Movements

- Muscles are attached to at least two points
 - Origin – attachment to a moveable bone
 - Insertion – attachment to an immovable bone

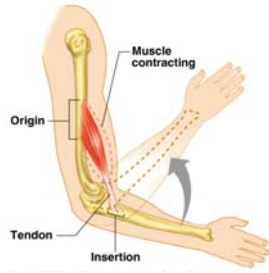


Figure 6.12

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Effects of Exercise on Muscle

- Results of increased muscle use
 - Increase in muscle size
 - Increase in muscle strength
 - Increase in muscle efficiency
 - Muscle becomes more fatigue resistant

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