

Movement

Nervous, Skeletal, and Muscular Interactions

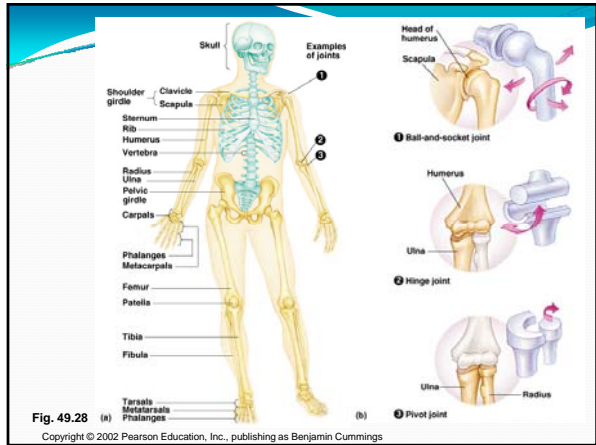


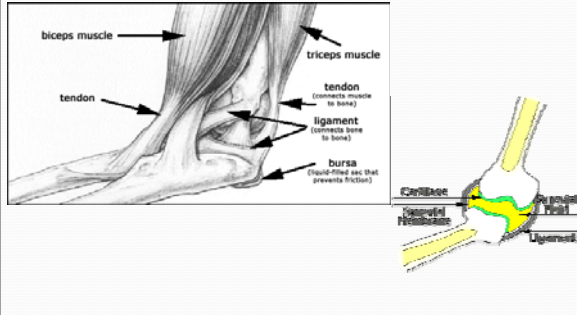
Fig. 49.28 (a) (b)
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Muscles and Skeletal Systems

- Muscles come in antagonistic pairs.

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Human Elbow Joint



- When an action potential meets the muscle cell's **sarcoplasmic reticulum (SR)** stored Ca^{2+} is released.

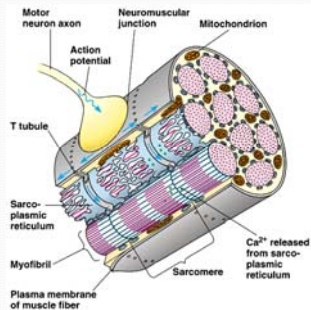


Fig. 49.35

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- Review of skeletal muscle contraction.

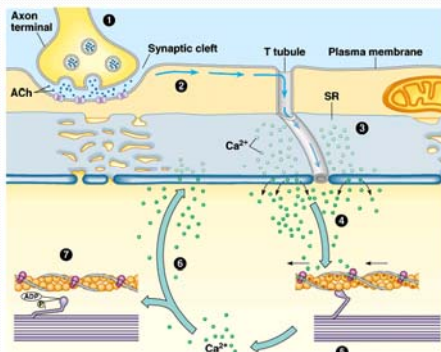


Fig. 49.36

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Movement of Tropomyosin

- At rest **tropomyosin** blocks the myosin binding sites on actin.
- When calcium binds to the **troponin complex** a conformational change results in the movement of the tropomyosin-troponin complex and exposure of actin's myosin binding sites.

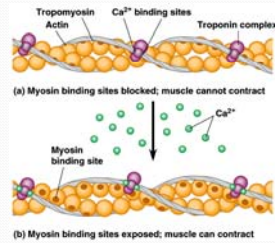


Fig. 49.34

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How Muscles Contract

- The **sliding-filament model** of muscle contraction.

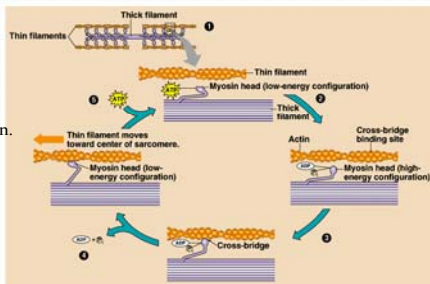


Fig. 49.33

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Muscles

- Structure and Function of Vertebrate Skeletal Muscle.
 - The **sarcomere** is the functional unit of muscle contraction.
 - **Thin filaments** consist of two strands of actin and one tropomyosin coiled about each other.
 - **Thick filaments** consist of myosin molecules.

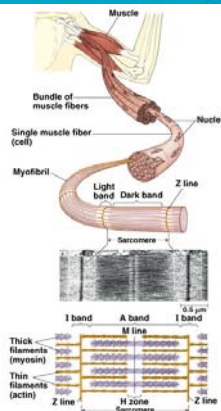
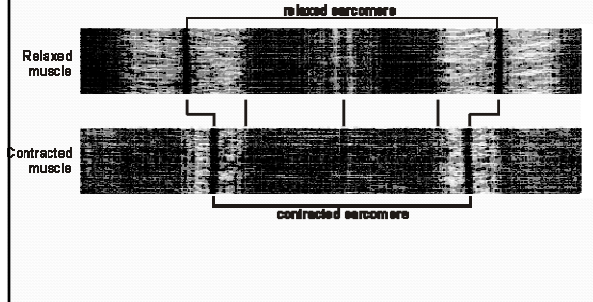


Fig. 49.31

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Looking at the Sarcomere



All or Nothing

- An individual muscle cell either contracts completely or not all.
- Individual muscles, composed of many individual muscle fibers, can contract to varying degrees.
 - One way variation is accomplished by varying the frequency of action potentials reach the muscle from a single motor neuron.

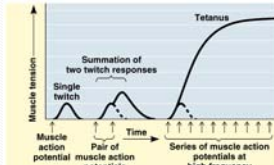
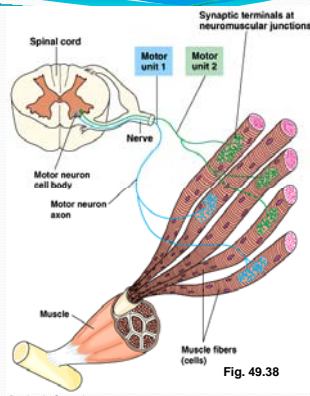


Fig. 49.37

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Strength

- Graded muscle contraction can also be controlled by regulating the number of **motor units** involved in the contraction.



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Recruitment

- **Recruitment** of motor neurons increases the number of muscle cells involved in a contraction.
- Some muscles, such as those involved in posture, are always at least partially contracted.
 - Fatigue is avoided by rotating among motor units.

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Fast Fibers

- **Fast muscle fibers** are adapted for rapid, powerful contractions.
 - Fatigue relatively quickly.

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Slow Fibers

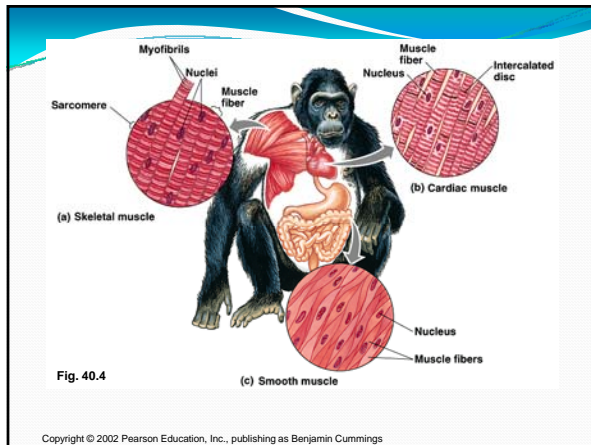
- **Slow muscle fibers** are adapted for sustained contraction.
 - Relative to fast fibers, slow fibers have.
 - Less SR → Ca^{2+} remains in the cytosol longer.
 - More mitochondria, a better blood supply, and **myoglobin**.

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Cardiac Muscle

- In addition to skeletal muscle, vertebrates have cardiac and smooth muscle.
- **Cardiac muscle:** similar to skeletal muscle.
 - **Intercalated discs** facilitate the coordinated contraction of cardiac muscle cells.
 - Can generate their own action potentials.
 - Action potentials of long duration.

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Smooth Muscle

- **Smooth muscle:** lacks the striations seen in both skeletal and cardiac muscle.
 - Contracts with less tension, but over a greater range of lengths, than skeletal muscle.
 - No T tubules and no SR.
 - Ca^{2+} enters the cytosol from via the plasma membrane.
 - Slow contractions, with more control over contraction strength than with skeletal muscle.
 - Found lining the walls of hollow organs.

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