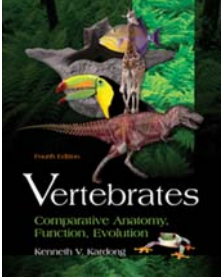


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# Chapter 10

Image PowerPoint

## The Muscular System

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### Muscle functions

- Generate forces to move bones or to prevent movement
- Produce heat for thermoregulation
- Muscles generate electricity; this is amplified in electric eels
- Electric organs are modified muscles
- Currents stun prey or defend against attack
- Can form a field around animal for detection of nearby objects

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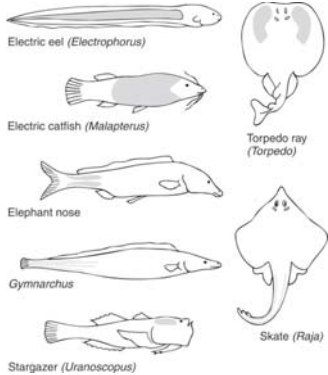
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**Many animals have electric organs; they evolved independently several times**

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## Muscle classification

Fiber color (red, white, pink)

Somatic muscles move body segments/regions

Visceral muscles control organs, ducts and glands

Voluntary muscles under conscious control

Involuntary muscles under autonomic control

Muscle fiber types include skeletal, cardiac and smooth

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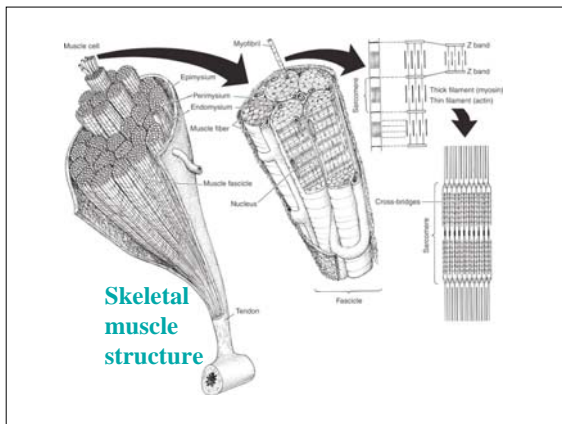
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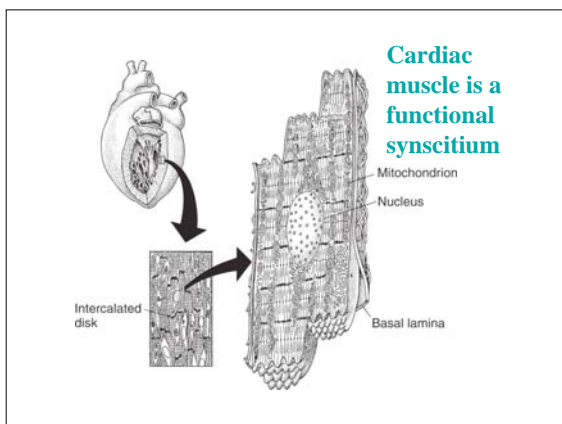
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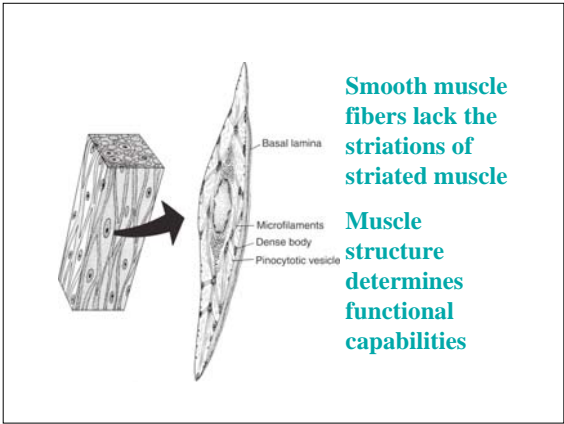
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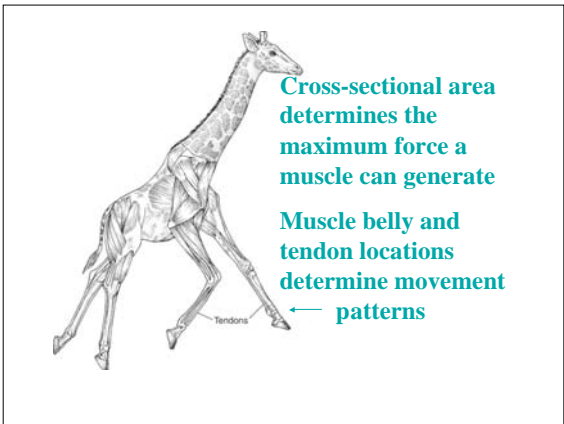
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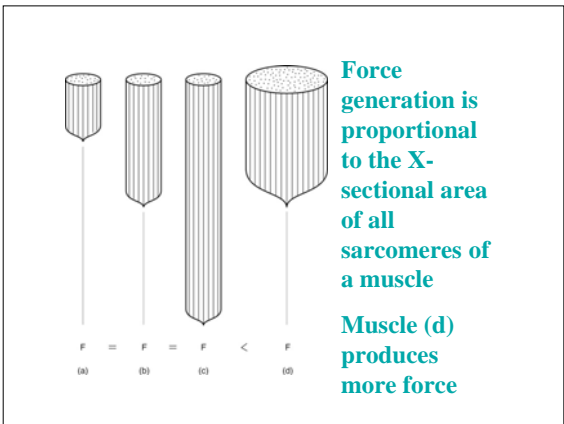
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- Morphological cross section of a muscle is perpendicular to long axis of muscle at thickest part
- Cross-sectional area of all muscle fibers is perpendicular to long axis is physiological cross-section
- Fiber orientation determines amount of tension that can be generated by a muscle

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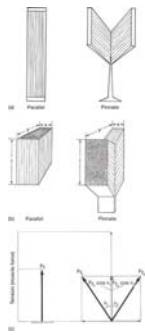
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**Parallel fibered muscles all fibers lie along the line of tension generation**  
**Pinnate fibered muscle fibers are oblique to lines of force and insert on a common tendon**

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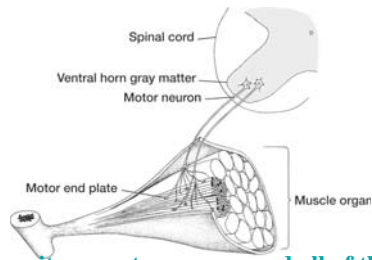
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**Motor unit – a motor neuron and all of the muscle fibers it innervates**

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**Recruitment of additional muscle fibers can increase the amount of force generated**

**This also applies to recruitment of additional muscles to increase the effectiveness of a particular movement**

**These muscles are synergists**

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- **Graded increase - Muscle fibers or entire muscles involved in a contraction can increase the force of the contraction in a controlled manner**
- **In contrast a motor unit response is all or none**

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**Velocity of shortening of a muscle is greater for a long muscle than a short one**

**Distance of shortening – sarcomere shortening in a long muscle is additive and therefore can be longer than in a short muscle**

**Longer muscles can move their attachments a greater distance than do short muscles**

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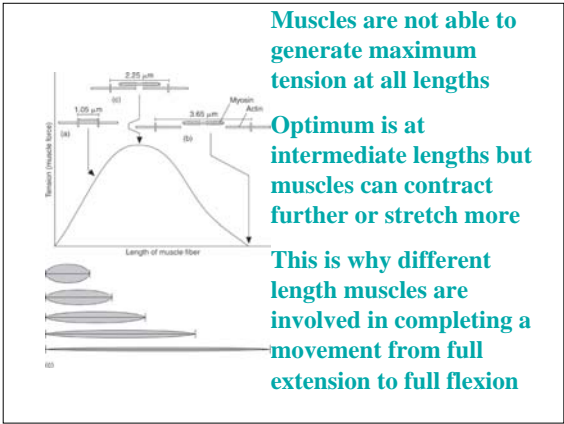
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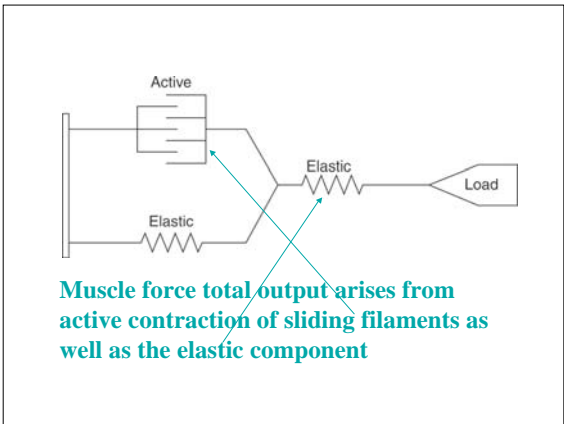
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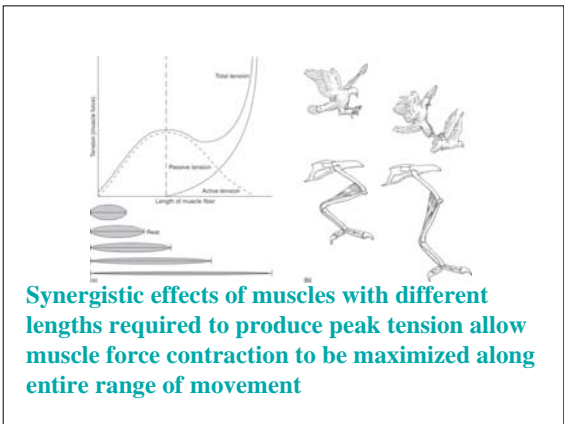
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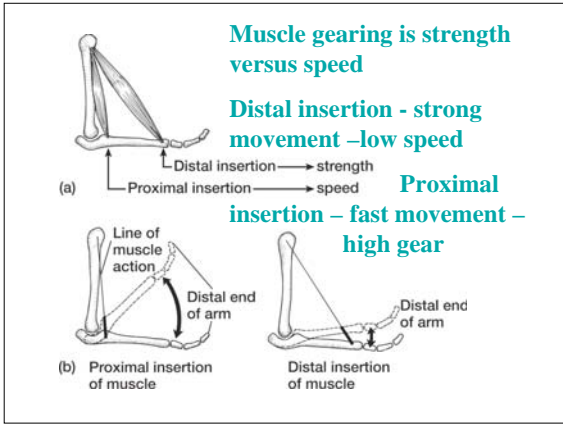
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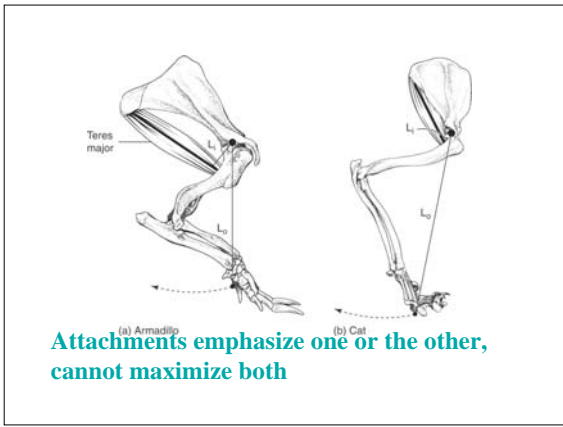
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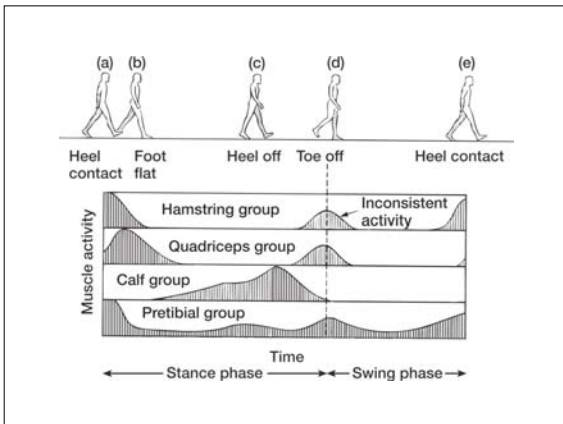
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**Two phases of muscle action:**

**Stance phase** – when rear of foot strikes ground until it is lifted again

**Swing phase** – from time toe is lifted until heel strikes

**Different muscles are active at different parts of stride**

**CNS coordinates the pattern of movement and muscle activity = motor control program**

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- **Muscle fiber types and numbers selected depending on the movement and types appropriate for the different levels of activity**
- **Muscles with complementary actions are synergists**
- **Muscles which oppose each other are agonists or antagonists**
- **Most important action of a muscle is prime action**
- **Muscle origin is a relatively fixed point**

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- **Muscle insertion is the part that moves the most**
- **Each site of origin of a muscle is a head**
- **Each insertion site is a slip**
- **Muscles that stabilize joints are fixators**
- **Flexors bend one part relative to other parts**
- **Extensors straighten a body part**
- **Adductors draw a part toward the midline**
- **Abductors draw a part away from the midline**

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