Organization of Muscles

• three kinds of muscle tissue
  – skeletal, cardiac, smooth

• specialized for one major purpose
  – converting the chemical energy in ATP into the mechanical energy of motion
The Functions of Muscles

• Movement

• Stability

• Control of openings and passageways
  – sphincters

• Heat production by skeletal muscles
  – as much as 85% of our body heat
Connective Tissues of a Muscle

• **endomysium**
  – thin sleeve of loose connective tissue surrounding each muscle fiber
  – allows room for capillaries and nerve fibers to reach each muscle fiber

• **perimysium**
  – slightly thicker layer of connective tissue
  – **fascicles** – bundles of muscle fibers wrapped in perimysium
  – carry larger nerves and blood vessels, and stretch receptors

• **epimysium**
  – fibrous sheath surrounding the entire muscle
  – outer surface grades into the fascia
  – inner surface sends projections between fascicles to form perimysium

• **fascia**
  – sheet of connective tissue that separates neighboring muscles or muscle groups from each other and the subcutaneous tissue
Compartment Syndrome

• fasciae of arms and legs enclose muscle compartments very snugly
• if a blood vessel in a compartment is damaged, blood and tissue fluid accumulate in the compartment
• fasciae prevent compartment from expanding with increasing pressure
• **compartment syndrome** – mounting pressure on the muscles, nerves and blood vessel triggers a sequence of degenerative events
  – blood flow to compartment is obstructed by pressure
  – if **ischemia** (poor blood flow) persists for more than 2 – 4 hours, nerves begin to die
  – after 6 hours, muscles begin to die
• nerves can regenerate after pressure relieved, but muscle damage is permanent
• myoglobin in urine indicates compartment syndrome
• **treatment** – immobilization of limb and **fasciotomy** – incision to relieve compartment pressure
strength of a muscle and the direction of its pull are determined partly by the orientation of its fascicles.
Muscle Attachments

- indirect attachment to bone
  - tendons
    - the collagen fibers of the endo-, peri-, and epimysium continue into the tendon then into the periosteum and the matrix of bone
    - *biceps brachii, Achilles tendon*

- direct (fleshy) attachment to bone
  - little separation between muscle and bone
  - muscle seems to immerge directly from bone
  - margins of *brachialis*, lateral head of *triceps brachii*

- some skeletal muscles do not insert on bone, but in dermis of the skin – muscles of facial expression
Muscle Origins and Insertions

• **Origin**
  – bony attachment at stationary end of muscle

• **Belly**
  – thicker, middle region of muscle between origin and insertion

• **Insertion**
  – bony attachment to mobile end of muscle

Figure 10.3
Functional Groups of Muscles

• action – the effects produced by a muscle
  – to produce or prevent movement

• prime mover (agonist) - muscle that produces most of force during a joint action

• synergist - muscle that aids the prime mover
  – stabilizes the nearby joint
  – modifies the direction of movement

• antagonist - opposes the prime mover
  – relaxes to give prime mover control over an action
  – preventing excessive movement and injury
  – antagonistic pairs – muscles that act on opposite sides of a joint

• fixator - muscle that prevents movement of bone
Muscle Actions Across Elbow

- **prime mover** - brachialis
- **synergist** - biceps brachii
- **antagonist** - triceps brachii
- **fixator** - muscle that holds scapula firmly in place
  - **rhomboids**

Figure 10.3
Intrinsic and Extrinsic Muscles

- **intrinsic muscles** – entirely contained within a region, such as the hand
  - both its origin and insertion there
- **extrinsic muscles** – act on a designated region, but has its origin elsewhere
  - fingers – extrinsic muscles in the forearm

![Diagram](image-url)

**Figure 10.29b**
Abdominopelvic Hernias

• **hernia** – any condition in which the viscera protrudes through a weak point in the muscular wall of the abdominopelvic cavity

• **inguinal hernia**
  – most common type of hernia (rare in women)
  – viscera enter inguinal canal or even the scrotum

• **hiatal hernia**
  – stomach protrudes through diaphragm into thorax
  – overweight people over 40

• **umbilical hernia**
  – viscera protrude through the navel
(b) Inferior view of diaphragm
Carpal Tunnel Syndrome

- **flexor retinaculum** – bracelet-like fibrous sheet that the flexor tendons of the extrinsic muscles that flex the wrist pass on their way to their insertions

- **carpal tunnel** – tight space between the flexor retinaculum and the carpal bones
  - flexor tendons passing through the tunnel are enclosed in **tendon sheaths**
    - enable tendons to slide back and forth quite easily

- **carpal tunnel syndrome** - prolonged, repetitive motions of wrist and fingers can cause tissues in the carpal tunnel to become inflamed, swollen, or fibrotic
  - puts pressure on the **median nerve** of the wrist that passes through the carpal tunnel along with the flexor tendons
  - tingling and muscular weakness in the palm and medial side of the hand
  - pain may radiate to arm and shoulder
  - **treatment** – anti-inflammatory drugs, immobilization of the wrist, and sometimes surgery to remove part or all of flexor retinaculum
Tendon sheath

Tendon of flexor digitorum profundus

Tendon of flexor digitorum superficialis

Lumbricals

Opponens digiti minimi

Flexor digiti minimi brevis

Abductor digiti minimi

Flexor retinaculum

Tendons of:
- Flexor carpi ulnaris
- Flexor digitorum superficialis
- Palmaris longus

First dorsal interosseous

Adductor pollicis

Abductor pollicis longus

Flexor pollicis brevis

Opponens pollicis

Tendons of:
- Abductor pollicis longus
- Flexor carpi radialis
- Flexor pollicis longus

(a) Palmar aspect, superficial