

Chapter 38

Protection, Support, and Movement

Integumentary System

- **Epithelial coverings** for both vertebrates and invertebrates
 - Protect underlying tissues
 - May be specialized for sensory or respiratory functions

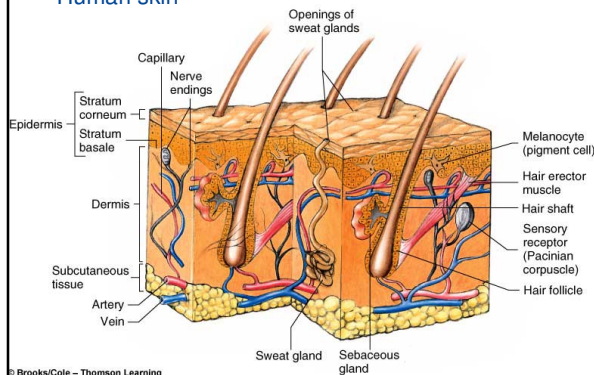
- **Integumentary system of vertebrates**
 - Skin
 - Structures that develop from skin
 - Fish scales
 - Mammal hair
 - Bird feathers

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- **Mammalian skin**
 - Hair
 - Claws or nails
 - Sweat glands
 - Oil glands
 - Sensory receptors

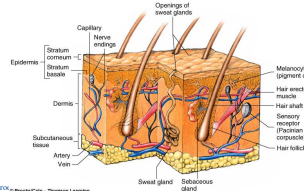
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Human skin



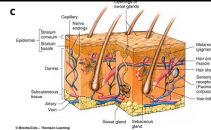
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- **Stratum corneum**
 - Outer layer of the epidermis
 - Consists of dead cells filled with keratin for strength and to reduce water loss



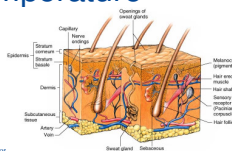
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- **Stratum basale**
 - Cells divide and are pushed upward toward the skin surface
 - Mature, flatten, produce keratin, and eventually die and slough off
- **Dermis**
 - Dense, fibrous connective tissue



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- **Subcutaneous tissue** in birds and mammals
 - Composed of insulating fat
- The feathers of birds and the hair of mammals help maintain a constant body temperature

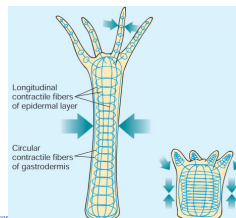


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Skeletal System

- **Skeletal system**
 - Supports and protects the body
 - Transmits mechanical forces generated by muscles

- **Hydrostatic skeleton**
 - Soft-bodied invertebrates
 - Cnidarians, flatworms, and annelids
 - Fluid in a closed body compartment
 - Transmits forces generated by contractile cells or muscle



• **Exoskeletons**

- Mollusks and arthropods
- Arthropod skeleton
 - Composed partly of chitin
 - Jointed for flexibility
 - Nonliving skeleton does not grow
 - Arthropods must molt periodically

Molting cicada



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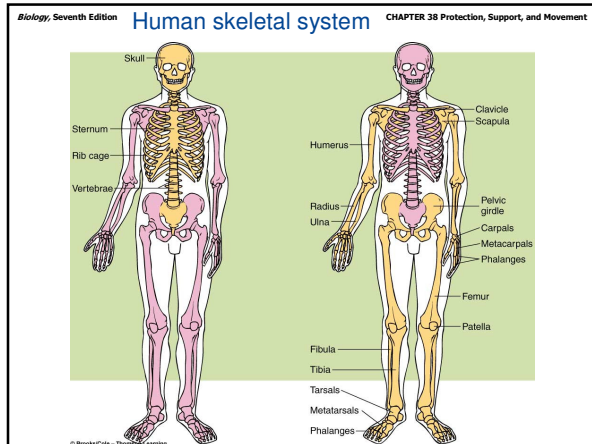
• **Endoskeletons**

- Echinoderms and chordates
- Internal skeleton that can grow
- Consists of calcium-impregnated tissue
 - Cartilage
 - Bone

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- **Vertebrate axial skeleton**
 - Skull
 - Vertebral column
 - Ribs
 - Sternum
- **Vertebrate appendicular skeleton**
 - Bones of the limbs
 - Pectoral girdle
 - Pelvic girdle

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- Cells that shape and remodel bone
 - **Osteoblasts**
 - Produce bone
 - **Osteoclasts**
 - Break down bone

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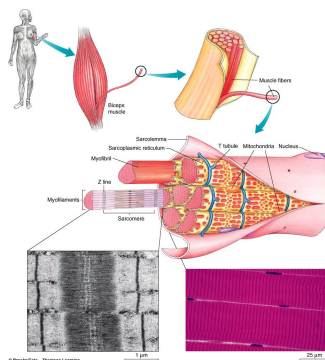
Muscular System

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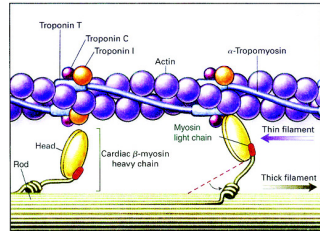
- Insect flight muscles
 - High metabolic rate required for flight
 - Large numbers of mitochondria
 - Tracheae (air tubes)

- Vertebrate muscle
 - Muscle tissue **contracts**
 - Moves body parts by **pulling** on them
 - **Types** of muscle
 - Skeletal – attached to bone
 - Smooth – soft internal organs (involuntary)
 - Cardiac – heart

- Skeletal muscle is made up of hundreds of muscle fibers



- The actin filament is pulled toward the center of the sarcomere



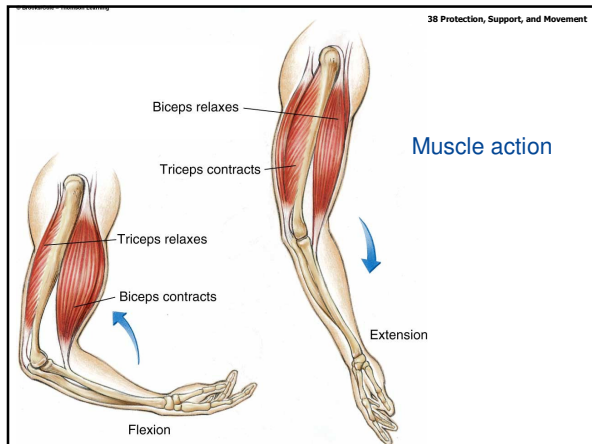
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- Myosin head binds a **ATP**
- Myosin head **detaches** from the actin ($ATP \rightarrow ADP + P$)
- Myosin **reattaches** to new active sites so that the filaments are pulled past one another
- Muscle **continues to shorten**

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- **Antagonistic** action of skeletal muscles
 - Agonist muscle contracts
 - Antagonist muscle relaxes
 - Groups of muscles work together (flexor and extensor)

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- **Slow (red) fibers**
 - Rich in mitochondria and myoglobin
 - Endurance activities
- **Fast (white) fibers**
 - Rapid response

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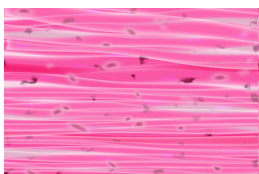
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- **Skeletal muscle**
 - Striated
 - Under voluntary control
 - Each elongated, cylindrical muscle fiber has several nuclei

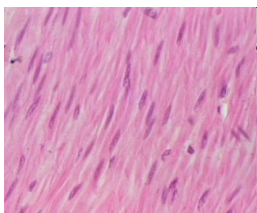
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- **Cardiac muscle**
 - Striated
 - Contraction is involuntary
 - Elongated, cylindrical fibers branch and fuse
 - Each fiber has one or two nuclei
 - Can contract without nerve impulse



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- **Smooth muscle**
 - Contracts involuntarily
 - Elongated, spindle-shaped fibers lack striation
 - Each fiber has a central nucleus
 - Responsible for movement of food through the digestive tract



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Muscle tissues

TABLE 37-3 Muscle Tissues	Skeletal	Cardiac	Smooth
Location	Attached to skeleton	Walls of heart	Walls of stomach, intestines, etc.
Type of Control	Voluntary	Involuntary	Involuntary
Shape of Fibers	Elongated, cylindrical, blunt ends	Elongated, cylindrical, fibers that branch and fuse	Elongated, spindle-shaped, pointed ends
Striations	Present	Present	Absent
Number of Nuclei per Fiber	Many	One or two	One
Position of Nuclei	Peripheral	Central	Central
Speed of Contraction	Most rapid	Intermediate (varies)	Slowest
Resistance to Fatigue (with repetitive contraction)	Least	Intermediate	Greatest

(a) Skeletal muscle fibers

(b) Cardiac muscle fibers

(c) Smooth muscle fibers

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