

Chapter 4: Support and Movement

Complete Sindh Textbook Board curriculum notes covering human skeletal system, joints, cartilage, muscle contraction, and common locomotory disorders.



Introduction to Support & Movement



Need for Support

Multicellular organisms require specialized skeletal structures to maintain body form against gravity and protect delicate internal organs.



Concept of Movement

Movement involves displacement of body parts or entire organisms from one place to another, driven by coordinated skeletal and muscular interactions.



Skeletal Types

- **Hydrostatic:** Fluid-based (e.g., earthworm).
- **Exoskeleton:** External hard shell (e.g., arthropods).
- **Endoskeleton:** Internal bony framework (e.g., vertebrates).

Human Skeletal System (206 Bones)

≡ Axial Skeleton (80 Bones)

- **Skull (22 bones):** Cranial (8) and facial (14) bones protecting brain and sensory organs.
- **Vertebral Column (26 bones):** Flexible spinal column protecting spinal cord.
- **Rib Cage (25 bones):** Sternum and 12 pairs of ribs protecting thoracic viscera (heart & lungs).

🦴 Appendicular Skeleton (126 Bones)

- **Pectoral Girdle:** Clavicle and scapula supporting arms.
- **Upper Limbs (60 bones):** Humerus, radius, ulna, carpals, metacarpals, phalanges.
- **Pelvic Girdle:** Hip bones supporting lower torso.
- **Lower Limbs (60 bones):** Femur, patella, tibia, fibula, tarsals, metatarsals, phalanges.

Cartilage and Bone Tissues

FLEXIBLE TISSUE

Cartilage

Dense, flexible connective tissue made of chondrocytes residing in lacunae. Found in nose tip, ear pinna, trachea rings, and articular ends of bones to reduce friction.

RIGID TISSUE

Compact Bone

Hard, rigid outer shell structured with Haversian systems (osteons) containing blood vessels, nerves, and osteocytes embedded in a calcium-phosphate matrix.

SPONGY INTERIOR

Spongy Bone & Marrow

Porcine network containing red bone marrow (site of blood cell production) inside bone epiphyseal ends, reducing weight while maintaining structural strength.

Joints and Their Classification

Movability Spectrum

Immovable (Fibrous)

Bones are tightly bound by fibrous connective tissue with zero movement allowed. Example: Sutures between skull cranial bones.

Slightly Movable (Cartilaginous)

Bones are connected by pads of fibrocartilage allowing limited bending. Example: Intervertebral discs between vertebrae and pubic symphysis.

Freely Movable (Synovial)

Contains synovial cavity with lubricating fluid. Includes **Hinge joints** (elbow, knee) and **Ball-and-Socket joints** (shoulder, hip).

Skeletal Muscles & Antagonistic Pairs

↔ Antagonistic Muscles

Skeletal muscles work in opposing pairs because muscles can only pull, never push. When one muscle contracts, its partner relaxes.

👉 Example: Arm Flexion & Extension

- **Biceps (Flexor):** Contracts to bend the elbow (lifts forearm).
- **Triceps (Extensor):** Contracts to straighten the elbow.

Sliding Filament Theory

Myofilaments

Myofibrils consist of thin **actin** filaments and thick **myosin** filaments organized into repeating units called sarcomeres.

Cross-Bridge Action

Calcium ions released upon nerve stimulation expose binding sites on actin. Myosin heads attach to actin, forming cross-bridges and pulling actin inward.

ATP Energy Requirement

ATP is consumed to detach myosin heads and reset them, shortening the sarcomere and causing muscle contraction.

Disorders of Skeleton: Arthritis & Osteoporosis

Osteoporosis

Bone resorption outpaces bone deposition, leading to porous, fragile bones prone to fractures. Commonly caused by calcium deficiency, aging, and hormonal changes.

Prevention: Adequate calcium, Vitamin D, and weight-bearing exercise.

Arthritis

Inflammation of joints accompanied by pain, swelling, and stiffness. Includes **Osteoarthritis** (cartilage wear and tear) and **Rheumatoid arthritis** (autoimmune joint damage).

Management: Anti-inflammatory drugs, physiotherapy, and lifestyle care.

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Chapter Review & Key Takeaways

Support and movement rely on the structural integrity of the 206 bones, flexible cartilage, synovial joints, and coordinated antagonistic skeletal muscle contractions.

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